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**LAND USE MANAGEMENT AND  
NPS CONTROL FOR THE  
DELAWARE ESTUARY:  
THE PENNSYLVANIA DEMONSTRATION  
PROJECT**

**FINAL REPORT**



**DELEP Report #94-05  
June 1994**

**Prepared by  
The Greeley-Polhemus Group, Inc.**

*Final Report:*

**LAND USE MANAGEMENT AND NPS CONTROL FOR THE DELAWARE ESTUARY:  
THE PENNSYLVANIA DEMONSTRATION PROJECT**

**Prepared for**

**Delaware Estuary Program  
Local Government Committee**

**by**

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**June 1994**





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## EXECUTIVE SUMMARY

Under provisions of the National Estuary Program, with support from the Federal Environmental Protection Agency, the governors of Delaware, New Jersey and Pennsylvania initiated planning for a tri-state program to reduce future pollution of the Delaware Estuary. The Greeley-Polhemus Group, Inc. was selected as consultants for the land use management phase. Planning and widespread discussion resulted in the finding that an initial and essential degree of control could be obtained by requiring new development and re-development in areas in the vicinity of the Estuary to provide best management practices to minimize the outflow of particulate pollution from storm runoff into the Delaware from streams within 40-hours time-of-travel. Following program implementation, subsequent effort would be directed at the significant and technically more complex issue of controlling stormwater pollution from existing development. The proposed program recommends changes to local land use planning and implementation of best management practices (BMPs) to control new sources of runoff pollution; these methods are anticipated to be more cost-effective compared to approaches to reduce runoff pollution from existing facilities. This program will be environmentally beneficial not only to the Delaware Estuary but also to the local receiving waters.

A demonstration project to explore, in more detail, the costs and the consequences of such a program within Pennsylvania has been conducted for the three municipalities of Aston Township, Middletown Township and Chester Heights Borough, in Delaware County, Pennsylvania.<sup>1</sup> The results have been discussed with the municipalities and the county concerned, with a broad-based advisory committee, and with various representatives of the Pennsylvania Department of Environmental Resources (PADER). Presumably, if the plan is approved it will become part of the CCMP. Although the results of such a program would be environmentally beneficial in the long-run to local streams as well as to the Estuary, the plan would require mandatory water quality regulations for stormwater management which, in Pennsylvania, are left to local

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<sup>1</sup> Much of the material in this report applies equally to portions of the estuary watershed within the States of Delaware and New Jersey; but specific application to conditions in those states is not included within the purposes of this demonstration project.





planning agencies and community initiatives. Based on surveys conducted during a previous effort (Delaware Estuary Program Land Use Management Inventory and Assessment Report, The Greeley-Polhemus Group, Inc., December 1990), it is unlikely that municipalities will impose such controls on their own initiative and the Commonwealth could not impose such controls without additional legislation. Several options have been considered to implement this nonpoint source (NPS) pollution control strategy, and two major issues were faced.

The first issue concerns whether controls should be imposed specifically for preservation of wildlife, or only to limit NPS pollution from runoff. As part of the program for all three states, NPS controls are recommended including buffer strips along the shores of the Estuary and its tributaries. It would be desirable if wildlife could be protected along these buffer strips, which generally correspond to sensitive habitat. However, another Delaware Estuary Program (DELEP) committee, the Habitat Task Force, is formulating a program for wildlife protection; it would be preferable not to initiate wildlife protection recommendations at this time while the other program is in process of development. Accordingly, while the buffer strip program will have the incidental effect of protecting wildlife by limiting activities along the water's edge, no additional wildlife controls are recommended beyond those required for NPS control.

A second basic issue to be faced is whether the programs could be implemented in Pennsylvania by means of modifications of existing legislation or by special legislation for the Delaware Estuary Program. First, it was decided that the Municipalities's Planning Code should not be the vehicle for the change. The code was recently amended following a lengthy process and any attempt to modify it is considered to be infeasible. Secondly, consideration was given to implementing the program by passage of a revised Stormwater Management Act and adoption of mandatory regulations (Appendices 1 and 2). This option would expand the current flood control purpose of the act to include control of stormwater quality through planning and would require use of best management practices, including buffer strips, for new construction and major property renovations. There is a traditional reluctance to accepting Commonwealth regulations in any area



of land use management. The imposition of mandatory controls is so different from the current statewide program that it is considered undesirable to implement the proposed program through the Stormwater Management Act. From a general legislative viewpoint, it appears preferable to implement the DELEP program through a separate Delaware Estuary Protection Act, limited in its application to the vicinity of the Delaware Estuary (Appendix 3).<sup>2</sup> This would avoid any direct concern from other parts of the state. Regulations for this new legislation would be required (Appendix 4). The provisions of this Delaware Estuary Protection Act would supersede applicable provisions of the Municipalities Planning Code and the Stormwater Management Act for communities located within the Estuary area. This option also would rely on mandatory implementation by the Commonwealth.

There remains the option of implementing the program through voluntary action by the municipalities concerned. If suitable encouragement and public education were utilized, highlighting the advantages to local streams and lakes as well as to the Estuary itself, and some financial incentives were provided, it might be possible to obtain the necessary program implementation by municipalities themselves without legislative action by the Commonwealth (Appendix 5). A Pennsylvania report, Guidance for Voluntary Local Government Implementation of Nonpoint Source Pollution Control: Protecting Local Streams and the Delaware Estuary (The Greeley-Polhemus Group, Inc., June 1994), offers helpful, specific guidance and model ordinances for voluntary program implementation in Pennsylvania (Pennsylvania "Guidance Document"). The following list presents the options considered for implementation in Pennsylvania of regulations controlling nonpoint source pollution in the Delaware Estuary.

- Excluded, considered infeasible:  
Municipalities Planning Code  
Revised Stormwater Management Act
- Potentially feasible:  
Delaware Estuary Protection Act with Regulations
- Interim:  
Voluntary Action by municipalities

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<sup>2</sup> This would be similar to the special legislation for protection of Lake Erie.



Implementation of the program within the three municipalities of the demonstration project would require changes in planning procedures as well as in stormwater management. Because of the decentralized nature of such programs in Pennsylvania, the specifics of application in the three municipalities are quite different. They are summarized in Part II.

A third issue, which arose only during the latter stages of the project, is whether the BMPs and buffer strips should be implemented throughout the major watersheds tributary to the Estuary or only within priority portions, defined by a given time-of-travel of flow to reach the Estuary. This issue is discussed as a matter of area strategy in Section 7.0. The decision reached will need to be applicable to all three states.

The DELEP proposal to provide BMPs for runoff pollution control within the areas adversely affecting the Estuary will require coordination with existing EPA and NOAA programs described in Appendix 6. Under Section 6217, some NPS control will be required in coastal areas. The DELEP program will be a forerunner of such requirements. Also, the EPA programs for runoff control in industries, major construction sites, and certain municipalities are now being developed. The DELEP will provide a basis for the EPA programs by recommending the degree to which NPS pollution control will be required initially for the purpose of protecting the Estuary.



## **PART I: THE TRI-STATE PROGRAM AS A WHOLE**

### **1.0 INTRODUCTION**

#### **1.1 Scope**

This report was designed to show the practicability of the recommended Delaware Estuary Land Use Management/Nonpoint Source Pollution Control Strategy within Pennsylvania. The demonstration project was carried out by The Greeley-Polhemus Group, Inc. under supervision of the Local Government Committee of the Delaware Estuary Program.

Part I of this report summarizes the strategy as a whole, which was developed prior to initiation of the demonstration project. Much of this material is covered in more detail in reports developed during the planning process, including: Briefing Paper No. 1: Delaware Estuary Environmental Problems and Existing Land Use Management Programs, September 1991; Briefing Paper No. 2: Discussion of Land Use Control Options to Protect Delaware Estuary Water Quality, November 1991; Briefing Paper No. 3: Options for Implementing Land Use Management and NPS Control for the Delaware Estuary, March 1992; Issues Paper: Options for Implementing Land Use Management and NPS Pollution Control for the Delaware Estuary, May 1991; and Delaware Estuary Program Land Use Management Inventory and Assessment Report, December 1990, all of which were prepared by The Greeley-Polhemus Group, Inc. Part II gives the conclusions arrived at through the demonstration project for the implementation action required by the three Pennsylvania municipalities.

#### **1.2 Background**

The Delaware Estuary is a 133-mile segment of the Delaware River and Bay that derives its unique ecosystem values from the mixing of freshwater from the Basin's tributaries and tidal saltwater from the Atlantic Ocean. The Estuary extends from the head of tide near Morrisville, Pennsylvania and Trenton, New Jersey, down to the mouth of the bay between Cape May, New Jersey, and Cape Henlopen, Delaware.





Although portions of the Delaware River watershed in New Jersey, Pennsylvania and Delaware drain directly into the Estuary from nearby shores, most of the drainage passes through tributaries (see Figure 1).

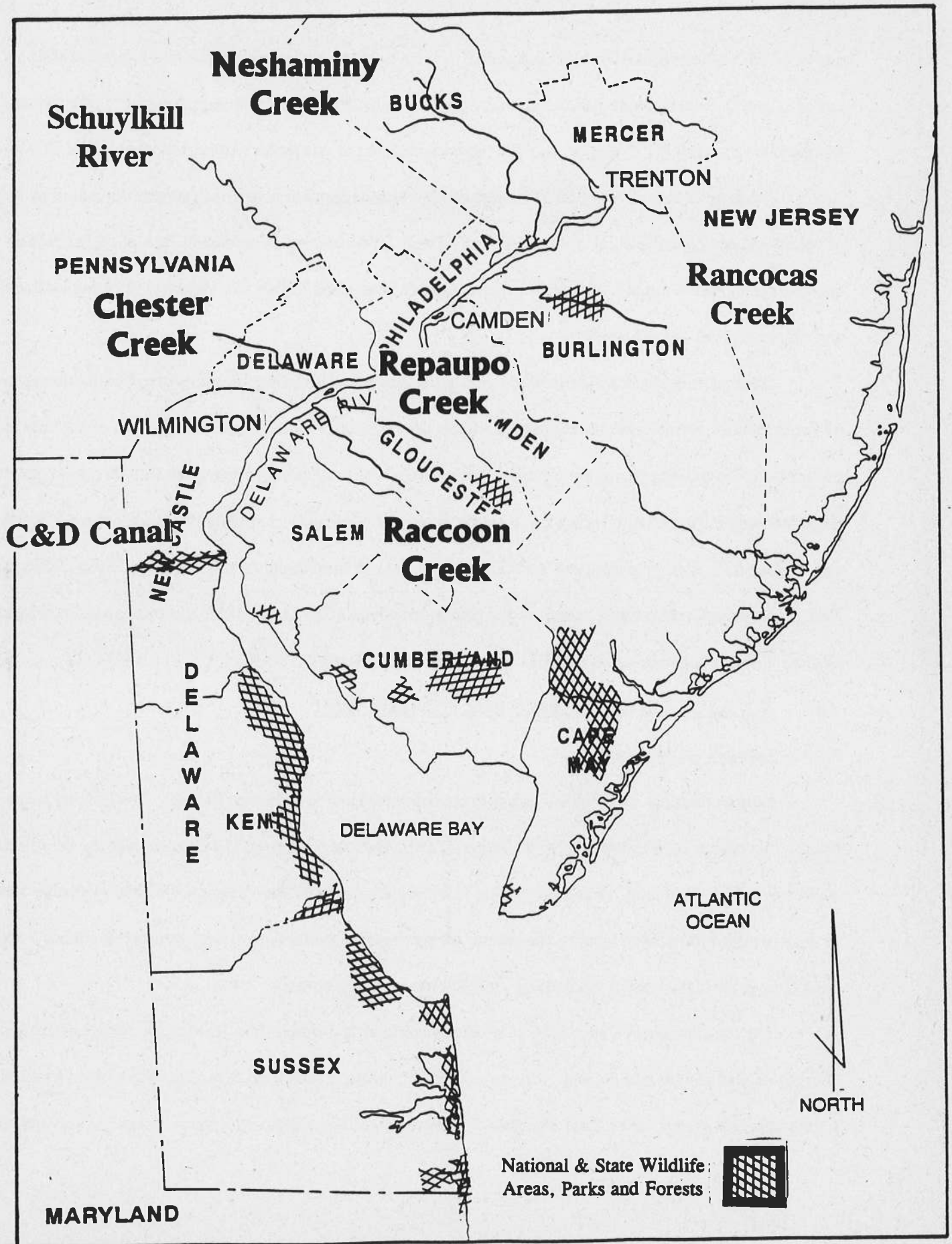
The Delaware River, one of the most intensively used rivers in the nation, provides economic benefits for industries, commercial businesses, utilities and governments throughout the region. It also provides recreational and aesthetic benefits to the citizens of the region. The population of the Estuary region is over five million people. Major urban areas include Trenton and Camden, New Jersey; Philadelphia, Pennsylvania; and Wilmington, Delaware. Heavy industry (steel, chemical, oil-refining and others) is located along the Estuary, making it one of the greatest concentrations of industry in the world. The Estuary is the fifth largest U.S. port overall in the nation and a 40-foot deep navigation channel at and below Philadelphia is maintained in the river by dredging.

Because of this development, the Estuary has been the focus of major environmental programs over the past several decades to restore its natural resources and many millions of dollars have been spent to treat wastewater and control discharges. Even though considerable progress has been achieved, the Estuary's water quality and living resources have by no means returned to the high quality, abundance and diversity which they had originally, and continue to be threatened by the actions of man. On-going activities and increased interest in future development along the shores of the Estuary must be carefully monitored and planned to ensure that the Estuary's continued recovery is not adversely affected. As a result, there is a need to understand the Delaware Estuary's problems, their sources and the interrelationships between water resources and the natural environment of the Estuary, both as an input to economic production processes and as a natural resource that provides habitat for fisheries and wildlife.

On May 31, 1988, the Governors of Pennsylvania, Delaware, and New Jersey nominated the Delaware Estuary to the National Estuary Program. On July 18, 1988, the Environmental Protection Agency approved the nomination and formally convened the Delaware Estuary Program. The Delaware Estuary Program (DELEP) has been undertaken and is being financed by the States of Delaware, New Jersey and Pennsylvania



**Figure 1: Estuary Map**





and the U.S. Environmental Protection Agency. It is intended to evaluate the Delaware Estuary, define its environmental management needs, and develop a Delaware Estuary Comprehensive Conservation Management Plan (CCMP). If approved, the program outlined in this report will become part of the CCMP.

The general objectives of DELEP, outlined by the management committee, targets the maintenance of habitat and ecological balance, water quality, recreation, advancement of commerce, pollution prevention, and also specifically targets restoration or maintenance of harvested finfish, invertebrates, bird populations, and other estuarine-related species.

Much more research will be required to define completely the relationships between specific measures of water quality control and corresponding effects upon the ecosystem. However, in view of the current processes of environmental deterioration resulting from too little control over economic development, it appears wise to initiate a land use management program now in the full knowledge that further research may show the need for additional measures, particularly in the area of controlling certain toxics and even nutrients. This is the basis for the strategy proposed in this report which relates to land use controls, consideration of additional long-range measures in the future is discussed in Section 2.3.

## **2.0 NEED FOR PROTECTION OF THE ENVIRONMENT**

### **2.1 Estuary Ecosystem**

Numerous species of fish and wildlife are supported by the Delaware Estuary. The Estuary houses over 130 species of freshwater and estuarine finfish, including herring, shad, carp, catfish, silverside, anchovies, and mummichog. Beyond providing a residential habitat for these species, the Estuary is also used as a spawning ground and nursery for marine species including bluefish, drum, flounder, menhaden, and weakfish. Shellfish found in the Estuary include blue crabs and oysters.

The Estuary houses a large array of resident waterfowl and shorebirds. Its location along the Atlantic flyway, coupled with its rich feeding grounds, make it a temporary host to such rare species as the arctic tern. Characteristically, estuaries have flourishing ecosystems. The Delaware Estuary is one of the richest,



providing habitat for resident fisheries, anadromous fish such as shad, shellfish, and a major link in the national flyways facilitating migratory bird passage towards Canada from wintering grounds in the gulf states and even Central and South America. The horseshoe crab's dependence on the Estuary as a spawning ground is of national significance. Horseshoe crabs form a vital link between fish and bird populations by providing a food source for migrating birds.

While water quality itself is a significant aspect of these species' total habitat, the shallows, marshes and wetlands that border on the Delaware Estuary and its tributaries are a critical determinant as well. Wetlands offer shelter and a food source, and a relatively stable water level, as well as water quality control through filtering of sediment and some pollutants. It is widely acknowledged that wetlands provide one of the most effective mechanisms for the control of nonpoint source pollution. A common environmental remediation technique in many areas is the construction of artificial wetlands to achieve a filtering and buffering effect. Thus the preservation of the Estuary environment must focus on both direct impacts to the water and impacts to the surrounding wetlands and sensitive habitat areas, as well.

## **2.2 Threats to Ecosystem**

The integrity of the Estuary's habitat, particularly its shores, can be threatened by both pollution impacts and physical activity. Physical activity results in immediate and obvious harm to the environment. Activities in environmentally sensitive areas disrupt habitat regions through noise and sediment loading and, more typically, result in net loss of habitat through destruction. Pollution impacts are often less immediate but equally devastating to biota and wildlife.

The water quality of the Delaware Estuary is heavily influenced by the intense use and unique character of the Delaware River system. Decisions are made daily by numerous entities that impact the water quality of the Estuary. Pollution to the Estuary emanates (1) from the various controlled and uncontrolled



point sources, and (2) from land use-related nonpoint sources (NPS).<sup>3</sup> Point source discharges from industries and municipal wastewater treatment plants are regulated by Federal and state agencies under the National Pollution Discharge Elimination System (NPDES) permit process. Because the Delaware Estuary Study Area is shared by three states, water quality management is the regulatory responsibility of three state environmental agencies, two U.S. Environmental Protection Agency regions (Regions II and III) and the Delaware River Basin Commission (DRBC), a basin-wide, interstate Federal compact agency. Major point sources of pollution have been the principal focus of Federal and state water quality protection and clean-up programs over the past several decades.

Point sources of pollution, those associated with a specific discharge or location, are the most obvious. Less well known are the nonpoint sources of pollution which originate as runoff from surface activities as diverse as residences, agriculture and highway use. Nonpoint source pollutants include a broad spectrum of toxic substances as well as nutrients.

Streams conveying urban runoff are characteristically environmentally damaged, both as regards to finfish and insect larvae. It is known that the pollutants in urban runoff are environmentally harmful to these biota and that the general elimination or reduction of these pollutants would benefit wildlife in the Estuary. This understanding has been the implicit basis of the Clean Water Act since 1972. Prudent management of the area's natural resources requires that steps be taken to prevent any increase of pollution in the Estuary and, to the extent possible, to reduce it even though the exact evaluation of the processes of environmental damage cannot now be stated. At the same time, existing programs to limit direct encroachment upon sensitive Estuary habitats should be strengthened.

Toxic pollutants entering the tributary waters flow into the Estuary and can be consumed by fish or benthic species. In even infinitesimal amounts, toxic substances can disrupt life-cycle functions in organisms:

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<sup>3</sup> For those unfamiliar with NPDES permit terminology, the term "nonpoint sources" (NPS), from a legal viewpoint, is restricted to only that diffuse pollution which does not reach streams through a pipe, ditch, or channel. Thus, street runoff is originally NPS, and if it percolates into the ground, it is still NPS; but if collected into a storm sewer, it becomes a point source. In this report, "NPS" is used to cover all dispersed sources of pollution.



for example, only one part per million of hydrocarbons absorbed in sediment can disrupt the life-cycle of oysters. In addition to functional damage, toxic substances can affect the organisms themselves or can lead to the accumulation of toxic substances in their bodies, to be consumed by other species, including humans.

Other non-toxic pollutants can have a harmful effect on biota. Nutrient damage to the environment is less direct than toxics, but can be equally harmful. Nutrient sources abound in the Estuary region. Nutrients such as nitrogen and phosphorus are typically found in fertilizers applied on both domestic and commercial farming and on lawns and gardens. Excess application or just poor timing of application can result in the introduction of large quantities of these nutrients into the waterbody. An excess loading of waterborne nutrients can lead to increased algal production, or algae blooms. The increase in plant production, and its consequent decay, removes oxygen from the water. Algae blooms are an example of oxygen-depleting waste loading, which can affect the dissolved oxygen content in the water. Low dissolved oxygen levels endanger plants and animals dependent on the oxygen content of Estuary waters, as has been demonstrated in the Chesapeake Bay.

The use and development of the Delaware Estuary region has resulted in serious degradation of the environment. Development and encroachment have affected the variety and numbers of species found. As elsewhere in the nation, wetlands have been cleared for farming and development. The U.S. Fish and Wildlife Service estimates the net national loss of wetlands at 50 percent over the last two hundred years. Habitat has been degraded, as well as destroyed, with fish populations declining, oyster production drastically reducing and water quality problems arising despite the various programs that exist to protect habitat and prevent pollution.

### **2.3 Status of Research and Action Programs**

Water quality analysis and modeling show that environmental goals can only be reached through a comprehensive approach including reoriented land use management; but the state-of-the-art is insufficient to precisely relate specific management actions to specific environmental goals. For example, the current low





harvest of oysters may have been adversely affected by overharvesting, failure to replace salvaged shells in the beds, predation by the oyster drill, or oyster diseases, as well as pollution. It is known that the oyster, which is a filter feeder, is very vulnerable to hydrocarbons in the form of particulates, which is the form in which hydrocarbons occur in urban runoff. However, water quality monitoring cannot at this time tell us how much the petroleum or other pollutants found in urban runoff contributed or could contribute to the decline in the oyster population.

The full scientific relationship between pollution and adverse environmental effects on the Delaware Estuary region remain to be developed. The Scientific Technical Advisory Committee (STAC) has outlined a five-year program to characterize the Estuary. This will outline the relationships between the various pollutants entering the Estuary, water quality, and the resulting environmental damage caused to diverse species. However, it is considered that an action program to control NPS pollution should be developed and implemented to complement on-going programs to control point source pollution. This will help satisfy requirements of the 6217 program.

If remedial action to control NPS pollution were not initiated until the full research program had been accomplished, there would be further significant deterioration of water quality and Estuary habitat. To prevent further deterioration at this stage is much more cost effective than to try to remedy the damage after it has occurred.

### **3.0 SOURCES OF NPS POLLUTION**

#### **3.1 General Review of Land Use Pollution**

Pollution in runoff from residential and commercial lands has been emphasized in a number of studies, including the Nationwide Urban Runoff Program (NURP).<sup>4</sup> The NURP program evaluated data collected between 1978 and 1983 from 81 sites in 22 of the 28 cities funded by the program. Of the 81 sites selected, 39 were completely or primarily residential, 14 were commercial, 20 were mixed commercial and residential,

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<sup>4</sup> "Results of the Nationwide Urban Runoff Program," Final Report, U.S. EPA, December 1983 (NTIS No. PB84-185552).



and 8 were runoff from open space in urban areas. The NURP study provides insight on what can be considered background levels of pollutants in runoff from residential and commercial land uses, as sites were carefully selected so they were not impacted by pollutant contributions from construction sites, industrial activities, or illicit connections.

One-hundred and twenty-one (121) samples at 61 sites were analyzed for 120 of the pollutants the Environmental Protection Agency (EPA) classified as priority pollutants. Heavy metals were by far the most prevalent priority pollutant found in the study, with copper, lead, and zinc each found in at least 91 percent of the samples. Sixty-three of the organics measured were detected, with concentrations of organic pollutants in discharges exceeding water quality criteria less frequently than with heavy metals. NURP found fecal coliforms in runoff from residential and commercial lands at concentrations approaching dilute sewage at a number of sites. Other pollutants were either not considered in the NURP study (e.g., oil and grease, floatables, chlorides, non-polar pesticides, asbestos, etc.) or were found at less frequencies. When analyzing annual pollutant loadings, it is important to recognize that discharges of runoff are highly intermittent and short-term loadings associated with individual events will be high and may have shock loading effects on receiving waters.

In May 1991, the Delaware Estuary STAC initiated a detailed study, "Land Use Conversion and Non-Point Source Pollution." That study will determine the current types and areas of particular land uses, the rate of conversion out to the year 2020, and the percentages of NPS loadings that can be attributed to these land uses. The study covered in this report made no attempt to quantify aggregates of the different pollutants or to project them into the future. However, from a review of readily available information, the general picture is clear. As forests, farms and open spaces are developed into residences and business districts, the total pollution entering the Estuary is correspondingly increased.

NPS pollution varies with land use. In terms of the usual land use categories, there is, in general, high NPS pollution from multiple-family residences, manufacturing, transportation and commercial development;





there is less pollution per acre from single-family residences, and there is still less from rural areas, forest and undeveloped land. One general indicator of the increase in NPS pollution is population growth. Of the 13 counties<sup>5</sup> adjoining the Delaware Estuary, census statistics for the years 1980 to 1990 show general growth. Although the City of Philadelphia declined in population by over 102,000 persons, or six percent, the other 12 counties had a net increase in population during the period 1980 to 1990 of 256,089, which is a 7.9 percent increase. Between 1970 and 1980, these counties had a population increase of 189,795, or 6.2 percent.

Corresponding census data for total housing for 1980 to 1990 show a decline of housing units for Philadelphia of 10,730, or 1.6 percent. Combined, the other counties had a total growth of housing units of 176,838, which is a 14.4 percent increase. A continuation of present trends of 7.9 percent decennial increases would result in a population increase of about 900,000 (24 percent) by the year 2030, giving a total of 4,404,000 persons outside of Philadelphia. This would most probably result in corresponding increases in NPS pollution in these counties and, unless controlled, further loss of sensitive habitats. There may be further decreases in population in Philadelphia, but without major changes in land use, it is questionable whether any major change in NPS pollution from Philadelphia can be predicted.

As a further, more detailed indication of the direction of land use as related to NPS pollution, land use development data tabulated by the Delaware Valley Regional Planning Commission (DVRPC) for the period 1970 to 1980 are available. These figures cover the seven Estuary waterfront counties in New Jersey and Pennsylvania, including Philadelphia. The data indicate that the area devoted to single-family housing in the DVRPC region increased by 28,820 acres, or 17.3 percent. The areas utilized for multiple-family housing, manufacturing, transportation, and commercial manufacturing facilities (all productive of heavy NPS loads) increased by 27,499 acres, or 16.1 percent. It is interesting to note that the total area used for agriculture declined by 23,888 acres, or 5.7 percent. The other major reduction, of approximately equal magnitude, was in forested and undeveloped land.

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<sup>5</sup> This includes the City of Philadelphia.



Changes in land use result in corresponding changes in NPS pollution. A table, published by the Metropolitan Council of Governments<sup>6</sup>, has been used in staff studies of the New Jersey Department of Environmental Protection and Energy to represent comparative values of NPS pollution typical of various land uses. This table (Table 1) illustrates the major differences among land uses for housing and commercial and industrial uses, the impervious cover of sites and types of pollutants found in stormwater. For example, regarding phosphorus, if NPS values from single-family housing with 10 percent cover are compared with NPS average values from townhouses and from light commercial and industrial developments, it is seen that the townhouses have slightly more than three times the NPS loadings of single-family housing while average commercial and industrial land uses generate almost five times the residential values. For biochemical oxygen demand (BOD), the comparison is almost the same. For lead, the townhouses have 1.75 times as much NPS loading as single-family housing, and light commercial and industrial has 2.5 times as much as residential. Such values are only approximate and they vary for other pollutants, but the general trend is corroborated by many other studies, all of which show that in general, multiple-family housing and commercial and industrial areas produce several times as much NPS pollutants as does single-family housing, and that single-family housing produces several times as much as unimproved land and rural land in general. There are also studies which show that highways carry similarly high amounts of NPS pollution, particularly of lead and hydrocarbons.

A certain amount of BOD, nutrients, and metals occur naturally in runoff, even from unimproved and forested land. In other words, there are certain levels of NPS "pollution" which are normal and ecologically desirable; it is only the excesses which cause problems. When complete studies have been made, it will probably be found that the excess of "pollution" which produces environmental damage corresponds fairly

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<sup>6</sup> Metropolitan Council of Governments, "Controlling Urban Runoff," July 1987.



**TABLE 1: ANNUAL STORM POLLUTANT EXPORT FOR SELECTED VALUES OF IMPERVIOUS COVER DEVELOPED FROM THE SIMPLE METHOD<sup>1</sup>**

Land Use <sup>2</sup>	Site Impervious	Total Phosphorus <sup>3</sup>	Total Nitrogen	BOD 5-DAY	Extractable Zinc	Extractable Lead
Pounds/Acre/Year						
Rural Residential	0	0.11	0.8	2.1	0.02	0.01
	5	0.20	1.6	4.0	0.03	0.01
	10	0.30	2.3	5.8	0.04	0.02
Large Lot Single Family	10	0.30	2.3	5.8	0.04	0.02
	15	0.39	3.0	7.7	0.06	0.03
	20	0.49	3.8	9.6	0.07	0.04
Medium Density Single Family	20	0.49	3.8	9.6	0.07	0.04
	25	0.58	4.5	11.4	0.08	0.05
	30	0.68	5.2	13.3	0.10	0.05
	35	0.77	6.0	15.2	0.11	0.06
Townhouse	35	0.77	6.0	15.2	0.11	0.06
	40	0.87	6.7	17.1	0.12	0.07
	45	0.97	7.4	18.9	0.14	0.07
	50	1.06	8.2	20.8	0.15	0.08
Garden Apartment	50	1.06	8.2	20.8	0.15	0.08
	55	1.16	8.4	22.7	0.16	0.09
	60	1.25	9.6	24.6	0.18	0.09
High Rise Light Commercial/Industrial	60	1.26	9.6	24.6	0.18	0.09
	65	1.35	10.4	26.4	0.19	0.10
	70	1.44	11.1	28.3	0.21	0.10
	75	1.54	11.8	30.2	0.22	0.11
	80	1.63	12.6	32.0	0.23	0.11
Heavy Commercial Shopping Center	80	1.63	12.6	32.0	0.23	0.11
	85	1.73	13.3	33.9	0.25	0.12
	90	1.82	14.0	35.8	0.26	0.13
	95	1.92	14.8	37.7	0.27	0.13
	100	2.00	15.5	39.2	0.28	0.14

1. P= 40 inches; Pj = 0.9, RV = 0.05 = 0.009 (I); C= Suburban values; A= 1 acre.
2. Rural Residential: 0.25 - 0.50; Dwelling Units (DU)/acre; Large Lot Single Family: 1.0 - 1.5 DU/acre; Medium Density Single Family: 2 - 10 DU/acre; Townhouse and Garden Apartment 10 - 20 DU/acre
3. These values are for New Development Sites only. For older urban areas, central business districts, sites with highways, or areas outside of the Middle Atlantic Region, use a more appropriate "C" value in Equation 1.1



closely to the portion contributed by housing and urban and industrial developments, and that the large mineral and organic content in runoff from forests, undeveloped land and general agriculture throughout the basin provides only a background level which is relatively undamaging.<sup>7</sup> If this is so, then gains of 14 to 16 percent in ten years in housing, commercial and industrial development and transportation may represent a proportionate gain in total damaging NPS pollution rather than being considered just a minor component of it. On this basis, there would be a 45 percent increase in damaging NPS pollution by the year 2020. Whatever the exact percentages, there is no doubt that the Delaware Estuary faces major increases in nonpoint source pollution in the future on account of changes in land use.

Future increases in nonpoint source pollution in the Delaware Estuary are related to new growth and development, the focus of this report. As forests, farms and open spaces are developed into residences and business districts, the total pollution entering the Estuary will correspondingly increase.

### **3.2 Sources of NPS Pollution**

In addition to considering the relative environmental vulnerability of various areas, consideration must be given to the relative toxicity or other harmful characteristics of the runoff itself. Best management practices (BMPs) should more strictly control that runoff which is inherently more apt to damage the environment or public health. Contaminated runoff and infiltration may be generally differentiated as to harmfulness in accordance with origin, as indicated in Section 3.4, below.

#### **3.2.1 Degree of Imperviousness**

When considering relatively large commercial and residential drainage basins, the most important factors influencing pollutant loadings are usually the degree of imperviousness and the amount of precipitation. NURP concluded that, for general planning purposes, the concentrations of pollutants in runoff from different large residential and commercial areas can be assumed to be roughly equivalent, but the degree

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<sup>7</sup> NPS pollution from agriculture includes nutrients, pesticides and sediments. There are programs in all three states to curtail these pollutants, and more needs to be done.





of imperviousness plays an important role in determining pollutant loads. Central business districts, which have a very high degree of imperviousness, will usually have the highest pollutant loadings per unit area. Commercial land uses can also have high degrees of imperviousness. The degree of imperviousness of residential lands is, in general, significantly lower than that found with commercial land uses and depends on the type of housing provided and the resulting density.

### **3.2.2 Runoff from Construction Sites**

The amount of sediment in stormwater discharges from construction sites can vary considerably, depending on whether or not effective management practices are implemented at the construction site. Uncontrolled or inadequately controlled construction site sediment loads have been reported to be on the order of 35 to 45 tons/acre/year. Sediment runoff rates from construction sites are typically 10 to 20 times that of agricultural lands. Over a short period of time, construction sites can contribute more sediment to streams than was previously carried over several decades.<sup>8</sup>

### **3.2.3 Runoff from Industrial Lands**

Discharges from separate storm sewers serving industrial lands may contain a large number of toxic constituents at high concentrations. In general, a greater variety and larger amounts of toxic materials are used, produced, stored or transported in industrial areas. Material management practices and atmospheric deposition can contribute to significant levels of toxic constituents in runoff from industrial sites. Many industrial areas have a high potential for illicit connections, spills, leaks and other sources, which may contribute a wide variety of pollutants to discharges from separate storm sewer systems. In addition, many heavy industrial areas have a large degree of imperviousness, which results in high volumes of runoff with high pollutant loads.

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<sup>8</sup> Metropolitan Washington Council of Governments, "Controlling Urban Runoff," July 1987, p. 1.4.



### **3.2.4 Runoff from Roads and Highways**

Pollutant concentrations in runoff from roads and highways are generally higher than those found in typical runoff from residential and commercial areas. Traffic-related pollutants come from leakage of oil, fuel oil, hydraulic fluids, coolants, incomplete combustion of fuel, clutch and brake lining wear, particulate exhaust emissions and debris from vehicles. Rust, dirt, metals, litter, plastic and glass are pollutants from weathering and wear. Lead is significant, but is generally decreasing. Petroleum hydrocarbons are of particular importance.

Research sponsored by the Federal Highway Administration indicates that the median concentrations of pollutants in urban road and highway runoff are typically three times higher than pollutant concentrations in runoff from roads in rural areas. Higher pollutant concentrations in urban areas were attributed to higher traffic volumes and more atmospheric deposition of pollutants.

Road maintenance activities, including right-of-way grass mowing, vegetation control, road repair, snow removal, and road deicing activities can significantly impact the pollutants in runoff. Spraying of herbicides and growth regulators has become an increasingly popular method to control vegetation along roadsides. Deicing salts can be major sources of sodium and chloride in stormwater runoff from roads and highways, and can also be a source of toxic metals (i.e., lead, nickel, chromium) and cyanide, which is used as an anticaking agent.

### **3.3 Land Use and Impacts Upon the Estuary**

Although the Delaware Estuary water quality has been severely impacted in the past, its water quality has considerably improved in recent years, due mainly to the efforts that have been made to curb municipal and industrial wastewater discharges. Further improvement in treatment is anticipated. However, the increasing processes of urbanization in the Delaware Estuary region will lead to corresponding increases in NPS pollution loadings which will result from changing land use. As indicated earlier, urban areas, multiple-family housing, highways and industrial and waste management facilities generate large quantities of





pollutants as compared to the rural and forested land and open space which they replace. This relationship is generally true for toxics, bacteria and viruses, and biochemical oxygen demand.

Regarding nutrients, the picture is somewhat different. Agricultural row crops utilize a lot of fertilizer and concentrations of livestock produce heavy loads of nitrates. In housing, poorly managed septic tanks can generate excess nitrates while lawns and gardens may also utilize too much fertilizer. The quantity of nutrients in runoff is determined more by particular practices employed than by the type of land use, but it is still true, in general, that more intensive development generates more nutrients as well as more toxics. The adverse impact of nutrients upon the environment is largely confined to static waterbodies. Nutrients from NPS pollution produce little harm to streams, but it is possible that they could cause serious problems such as eutrophication and phytoplankton blooms in the Estuary and adjoining embayments and in marinas built with insufficient circulation. This situation is being evaluated by the STAC. The situation in the Chesapeake Bay constitutes a warning as to what could happen in the Delaware Estuary if present trends continue. There may also be special problems with pesticides and other agricultural chemicals. Such pollutants must generally be handled by source controls rather than BMPs.

In the next few years, in most of the counties bordering the Estuary, there will be major increases in multiple-family housing, business districts, industry, highways, parking areas and in single-family housing, with corresponding reductions in open space and agriculture. Unless a more effective strategy is adopted, these changes in land use will result in a major increase in bacterial contamination, toxics and nutrients in storm runoff, and a corresponding increase in pollution of the Estuary. Moreover, as one looks further into the future, there is no clearly definable end to this tendency in sight.

### **3.4 Potential Harmfulness**

Some types of land use are potentially harmful to the environment because their runoff is characteristically polluted. Gas stations are an example.



A harmfulness index of stormwater runoff, classified by origin, may be summarized as follows:

CLASS OF HARMFULNESS	
1	From industrial and waste management sources, multiple-family housing, commercial facilities such as gas stations and shopping centers, highways, urban areas, and single-family housing with lot sizes smaller than one-third acre per housing unit
2	From single-family housing developments, with lot size one-third acre or larger per housing unit, and runoff from lesser roads
3	Undeveloped land or unfertilized vegetation

Unless demonstrated to be otherwise in specific situations, classifications 1-3 are in descending order of pollutant loading, the most intense being first. Of course, in cluster housing, the pollutant loading per acre for dense development is compensated for by reduced acreage developed. In addition, there are other categories of NPS pollution which are highly variable in their pollutant loading, including agriculture and road salts. Within the category of agricultural use, certain land uses such as fertilizer storage and cattle feed lots probably deserve to be treated as Class 1, whereas normal pasture or wood lots are probably Class 3.

The classification of industries and waste management sources depends upon the circumstances. Some sources have such polluted runoff that even a classification of "1" is not adequate. In such cases, the ordinary BMPs for urban runoff will be insufficient. Source controls and/or treatment may also be required.

It is easy to point out that there are some special cases in which harmfulness varies somewhat depending upon the exact nature of the environment downstream. Nevertheless, for general classification purposes, the harmfulness index provides a useful guide to the environmental effects of any proposed land use when considered with respect to environmental sensitivity of the area affected downstream.

### 3.5 Remoteness of Sources

All parts of the Delaware River Basin undoubtedly contribute to some extent to NPS pollution of the Estuary. However, the more remote portions contribute very little. Contaminants only reach the Estuary by



overland flow if they originate within a short distance. Contaminants conveyed by tributaries or other channels are reduced during time-of-travel in those tributaries by a number of processes. Biodegradable material diminishes with the elapse of time. Total particulate content is reduced as the sediment load passes downstream. Volatile organics evaporate. Nutrients may be absorbed by vegetation. Pathogenic bacteria in streams normally diminish in number with time. These processes are discussed further in Section 7.0. From a scientific viewpoint, the highest priority should be given to controlling NPS pollution immediately adjacent to the Estuary, with a second priority applied to areas from which runoff reaches the Estuary in a relatively short time.

Part of the runoff into the Estuary occurs by sheet flow across the shores. In addition, a far greater part comes from upstream on the Delaware River, from tributaries, and from intermittent overland flow channels. Although it is desirable to provide a substantial degree of reduction of pollution for this channel flow from the upper portions of the main stem and tributaries, the elapse of time and travel distance during flow helps to effect reduction of pollutants. For intermediate areas closer to the Estuary, the need for control is greater and it may be important to focus the use of BMPs on these nearby sources. On the other hand, there is a strongly held view that runoff pollution control measures should be applied by complete watersheds of major tributaries.

### **3.6 Objectives, Land Use Controls and Habitat Protection Needs<sup>9</sup>**

The goals and objectives of the DELEP summarized in the introduction could be implemented by a number of on-going Federal, state and local programs, but actual progress toward achieving these goals is slow and uneven. In some respects, improvement is lagging behind increasing pollution sources. The DELEP goals and objectives relate to biota of the Estuary and their habitat, to recreational use and amenity value of the Estuary, and to public health of the users. The strategy proposed will relate to water pollution as it enters the

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<sup>9</sup> The material in this section is largely summarized from Briefing Paper No. 1: Delaware Estuary Environmental Problems and Existing Land Use Management Programs, (The Greeley-Polhemus Group, Inc., September 1991) and recent EPA regulations.



Estuary either directly from tributaries or from upstream and to land use which impacts upon sensitive habitat associated with the Estuary. [Thermal pollution, radiological pollution, boating sanitation, marine oil spills, and airborne pollution are regarded as outside the scope of this report.] The programs of a number of Federal agencies are involved, but particularly those of the Environmental Protection Agency and the Department of Agriculture. The planning and coordinating efforts of the Delaware River Basin Commission (DRBC) are relevant. Official action in implementing the DELEP program will have to come from the agencies of the three states (Delaware, New Jersey and Pennsylvania) and from their political subdivisions, supplemented by Federal agencies. Accordingly, the current status of existing programs, as related to the Delaware Estuary, is important.

Various existing programs and authorities have powers which could be exercised to protect the Estuary in the manner outlined in the DELEP Program. However, the survey of existing practices in the Delaware Estuary Program Land Use Management Inventory and Assessment Report (The Greeley-Polhemus Group, Inc., December 1990) indicates that the inherent powers of the local government to protect the environment have not been fully exercised. Some of the older programs have had substantial effects, in some respects, particularly the EPA/state programs of point source pollution control and the SCS/conservation district/state programs of runoff and erosion control. Other, newer programs are still in the development stage and are commented on in Appendix 7.

#### **4.0 CONTROL BY BUFFER STRIPS**

A high priority for protecting the Delaware Estuary and its associated wildlife habitat is buffer strips applied to areas immediately adjacent to the Estuary. If such buffer strips around the shores of the Estuary are retained in natural vegetation, they will remove sediment and both dissolved and particulate pollution from runoff. The reservation of such buffers reduces activities along the water's edge which might generate pollution, and preserves the natural habitat. Such buffers have been recommended and/or adopted in a variety of forms.





A distinction is necessary between buffer protection of wetlands and of other shorelines. Wetlands in the Delaware Estuary are extensive. Tidal wetlands are protected against encroachment by Federal law, and control is exercised by both state and Federal agencies. This control consists of a permitting process which may allow some construction on wetlands to proceed. In New Jersey, a 300-foot buffer strip is required by the state for tidal wetlands as well as a buffer strip for non-tidal wetlands, which extends between 75 to 150 feet from exceptional value wetlands and 25 to 50 feet from intermediate value wetlands. Such buffers preferably include filter strips of vegetation. Wetlands have sometimes been used to remove pollution from incoming drainage, but in the proposed guidance for coastal NPS pollution<sup>10</sup>, management practice does not allow the alteration of wetlands to improve water quality for the benefit of other functions.

Buffer strips along streams have been widely discussed and have been included in a plan for protection of the Cooper River watershed in New Jersey. Buffers have sometimes been applied as stream corridors, which are similar to estuarine buffers.

In North Carolina, special permits are required for any land-disturbing projects within 75 feet of estuary shores or of designated wetlands. Local and state permitting officials encourage permit applicants to provide a 75-foot setback in order to avoid the permit process.

The Coastal NPS Guidance, under the heading of Environmental Reserves, suggests stream buffers of 50-foot width for low order headwater streams and 200 feet or more for larger streams. It suggests buffers of 25- to 50-foot width for either tidal or non-tidal wetlands and of 100 feet from mean high tide for coastal areas other than wetlands. Also in this guidance, design criteria for vegetative filter strips include a minimum width for a grass or turf strip of 20 feet, with 50 to 75 feet preferable.

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<sup>10</sup> "Proposed Guidance Specifying Management Issues for Sources of NPS Pollution in Coastal Areas." U.S. E.P.A., Federal Register, June 14, 1991 (56 FR 27, 618).



Buffer strips have also been adopted or recommended for protection of water supply reservoirs.<sup>11</sup> In the past, a minimum buffer strip width of 50 feet has been commonly recommended for water supply reservoirs. The authors in the first cited reference recommended a minimum buffer width of 300 feet for reservoirs used directly for withdrawal of water, a width of 100 feet for other water supply reservoirs and a width of 50 feet for tributary streams, although their own research had indicated that narrower buffers have usually been adopted.

It seems clear that buffer strip protection should be afforded to the Estuary to the extent practicable. The intention is to establish a minimum width of buffer implementable in all three states which could be increased in appropriate situations. The purpose is to exclude development which is likely to cause pollution from spills or runoff. Buffers would be essentially site plan set-backs for any new development or major re-development subject to exceptions for water-related activities, variances, rights-of-way, etc. Site regrading would require a properly designed, unfertilized grass strip buffer at least 20 feet wide. Minimum buffer widths recommended are as follows:

- |                     |          |
|---------------------|----------|
| ● wetlands          | 50 feet  |
| ● other shores      | 100 feet |
| ● large tributaries | 100 feet |
| ● small tributaries | 50 feet  |

These correspond to the widths of buffers proposed by EPA under the Section 6217 program for Coastal NPS Pollution Control, except that EPA recommended 200 foot width buffers for large tributaries. Some refinements in the application of buffer strips should be explored and exemplified in demonstration projects. In particular, it may be desirable to provide for some exceptions in the case of very small building lots already in existence. It is assumed that each state will accept a common minimum standard and that they

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<sup>11</sup> G.H. Niewswand, R.M. Hordon, T.B. Shelton, B.B. Chavooshian, and S.L. Blarr, "Buffer Strips to Protect Water Supply Reservoirs: A Model and Recommendations," Water Resources Bulletin, 26, 6, 959-966, December 1990 and W. Whipple, Jr., "Buffer Zones Around Water Supply Reservoirs," Journal of Water Resources Planning and Management ASCE, 119, 4, July/August 1993, p. 495.



will incorporate other requirements, such as provisions for access, variances, etc., which appear desirable, or more stringent controls.

In those areas where more stringent controls than those proposed here exist, or may be accepted locally, they are consistent with this strategy's intent to establish effective minimum standards and are supported and encouraged. For example, in New Jersey regulations for more stringent controls providing for wider buffers to protect wetlands (150 feet for fresh water wetlands and 300 feet for tidal wetlands) would apply to the New Jersey portion of the Estuary. In general, the New Jersey Coastal Area Facilities Review Act (CAFRA) regulations protect shorelines against development, with varying provisions for different types of shorelines, i.e., bluffs, beaches, filled waters edge, and flood hazard areas. The CAFRA regulations for non-wetlands areas differentiate between conditions applicable to different types of shorelines, and in areas where they exceed the minimum buffer width recommended, the CAFRA restrictions would apply. However, for the large portion of the New Jersey Estuary shores outside the CAFRA area (above Pennsville), the minimum recommended buffers would need to be established.

The vegetative filter strips in buffers are not designed to control either tributary or storm sewer flow. The greater part of runoff pollution passes a buffer through a pipe, ditch or channel, whether or not the facility to be constructed is within the buffer itself. Nonpoint source pollution from such sources must be handled by means other than buffers. From the environmental viewpoint, such a development does not encroach upon shoreline habitat, but the effect upon water pollution is virtually the same as though the development were upon the banks of the Estuary. Extra requirements of treatment, control or special preventive measures to minimize NPS pollution should be imposed upon runoff from such developments.



## 5.0 CONTROL BY LAND USE MANAGEMENT

### 5.1 General

After basin-wide analysis in the assessment report<sup>12</sup> and discussion with officials of municipalities, it was concluded that implementation of the recommended DELEP plan would be most effectively assured by mandatory state action. Although all concerned seem generally interested in environmental protection of the Estuary, the economic, public health and other local interests of each municipality are related mainly to that municipality, whereas conditions in the Estuary as a whole seem more remote. The benefit in protecting local waters in the interests of downstream areas has not been generally appreciated. Protection of the Delaware Estuary will require action by all three states. If approved, the DELEP plan would become part of the CCMP.

In order for the program to be implemented throughout the region by mandatory state action, each state will eventually have to:

- Identify or establish an agency to assume the lead role for intrastate programs coordination and provide staffing for that agency.
- Establish an interstate coordination capability or assign an existing entity (i.e., DRBC or DELEP Management Committee).
- Establish uniform criteria for delineation of zones of influence, use of BMPs, buffer strips, planning and zoning, etc.
- Amend relevant state legislation and add regulations as needed to implement strategy based on individual state choices.
- Identify and notify municipalities in the zone of influence.
- Provide budgets for program funding.
- Initiate educational programs and increased public participation.
- Provide planning, research, monitoring, and program evaluations.

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<sup>12</sup> The Greeley-Polhemus Group, Inc., Delaware Estuary Program Land Use Management Inventory and Assessment Report, The Greeley-Polhemus Group, Inc., December 1990.





If these recommendations are implemented, an effective program will be in place to check the growth of NPS pollution to the Estuary. The framework will be suitable to the overall objectives of the DELEP program and control of existing sources of NPS as well.

Prior to building any new facility which has a potential for pollution, consideration should be given as to whether it is preferable to site the facility at some other location. For example, since it is quite clear that gas stations, which cannot be eliminated, are prime sources of NPS pollution, it is better to control land use so that such facilities will not be located in areas from which their runoff would normally reach priority areas in a short time or which would infiltrate into the Estuary. Wherever the facility is to be sited, appropriate BMPs can be required.

## **5.2 Local Land Use Control**

Typically, local comprehensive plans reflect local economic development objectives and provide the basis for zoning. Updated occasionally, these community plans and related zoning and site development procedures may be modified to simultaneously provide for local interests and Estuary and stream protection. There is need to reorient local land use comprehensive planning, zoning and subdivision ordinances, and review procedures to include requirements for BMPs and buffers as described in Section 8.0, and also to give greater consideration to sensitive habitat and other environmental aspects. Site planning and environmental review will be accomplished as established by either state or local authority. In addition, coastal zone staffs will perform review and permitting activities within coastal zones.

Because of the time that will be needed to establish a complete program, efforts should be undertaken without delay to implement good land use practices that will protect local streams and the Estuary. The Pennsylvania "Guidance Document" discusses this possibility.



### 5.3 Land Use and Infrastructure Planning

There is a similar need to reorient state and national planning and review of infrastructure, including highways, roads, and water and sewer facilities. Each state's role in planning infrastructure should be coordinated internally by improved intrastate planning procedures and review. Interstate coordination should facilitate project review of regional infrastructure planning and analysis of impacts. Any Federal agency planning to build infrastructure will be requested to conform to the Estuary planning and drainage criteria. In addition, Federal program consistency requirements for projects funded by Federal sources should apply.

### 5.4 Best Management Practices

It is recommended that within the zone of influence, two levels of best management practice be used: standard BMPs, which would remove a major part of particulate pollution, and special BMPs, which would remove a greater part. The technical basis for these requirements is explained in a recent lead article in the Water Resources Bulletin<sup>13</sup> and in the recently published manual of practice The Design and Construction of Urban Stormwater Management Systems, ASCE, Manual No. 77, 1993. The current stormwater management regulations in Delaware are equivalent to standard BMPs. The stormwater management regulations in New Jersey, which are applied in many municipalities but not mandatory statewide, also provide a degree of control consistent in most respects with standard BMPs.

### 5.5 Effectiveness of BMPs

Besides limitations on type of land use, there are essentially two classes of BMPs to limit runoff pollution: source controls and structural controls. The source controls are designed to prevent polluting substances from entering runoff or other waters. The structural controls are designed to deal with pollution once it has entered the water or the conveyance system. Structural controls include a variety of at-site practices, settlement of particulates, infiltration and occasionally, other forms of treatment. Most of the

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<sup>13</sup> Whipple, William Jr. "Best Management Practices for Stormwater and Infiltration Control", Water Resources Bulletin, December 1991, pp. 895-902.



structural provisions are usually combined into systems of stormwater management. Many of the source controls, however valuable, are not enforceable by land use management and therefore fall outside the scope of this report.

In the past, stormwater management systems were built mainly to reduce flood damages, but they have now evolved so as to provide the principal means of controlling NPS pollution from new development. Details are given in the Appendix 6.

The EPA guidance for NPS control in coastal waters enumerates Best Management Practice and Best Management Measures for different fields of activity which have varying degrees of relevance to land use management. Major categories of management measures recommended relate to agriculture, forestry, urban sources of NPS, marinas and recreational boating, hydromodification, and wetlands and biofiltration. From the viewpoint of Delaware Estuary land use management, forestry and hydromodification are relatively unimportant. The control of agricultural practices is important to water quality in the Delaware Estuary, especially as regards fertilizer use, feed lots, dairies, disposal of animal wastes, and dead animals but the decrease in acreage devoted to agriculture in the Delaware Estuary region limits the extent that land use management of new agricultural developments can influence total NPS pollution.

The chapters in the EPA Coastal NPS Guidance Manual on urban (and urbanizing) areas NPS are the most important for this study, particularly as regards on-site sewage disposal, water quality aspects of stormwater management and the section on environmental reserves. The provisions for protection of wetlands and biofiltration (e.g. vegetated filter strips) and for marinas and recreational boating are also significant. Appropriate reference is made to this guidance in the sections which follow.

## **5.6 Local Environmental Benefits of Program**

As far as water quality is concerned, the effect of BMPs would be to reduce the additional runoff pollution which would otherwise be contributed by new developments. Therefore, this part of the program would not be remedial in nature. It would not result in an improvement in existing water quality of the



streams, but would minimize environmental degradation which would otherwise take place. This would be environmentally beneficial locally and downstream.

The other local environmental benefit would result from creation of the buffer strips. They would provide protected areas along both banks of streams which would constitute narrow stream corridors. While the strips would not be wide enough to preclude residence along the banks, they would ensure that homes and other improvements would be set back, with vegetated strips, to minimize pollution-causing activity along the stream banks. The buffer strips would provide some water quality benefits for the future as well as protecting streamside habitat.

Therefore, although the protection of the Delaware Estuary is the official and primary purpose of the program, it would definitely act to minimize environmental pollution of local streams which would otherwise occur as well as ensure preservation of stream corridors along streams which are not already developed.

## **6.0 BMP SELECTION APPROACH**

The BMP program recommended in this study is technology-based. It is intended to make some improvement in reducing existing pollution of the Estuary and to prevent the further deterioration in water quality which, without this program, will inevitably occur. The program is designed mainly to minimize pollution of the Estuary itself, but within the areas where action is recommended, it will help achieve other environmental objectives (e.g., local stream protection) which otherwise would have to be pursued by different and overlapping NPS control programs. First, it must be determined whether a given type of development will be permitted to be built in a given location; and then some form of guidance is needed as to the BMPs to be required to reduce the extent of pollution or to lessen its impact upon the receiving waters.

In deciding whether or not it is necessary to apply BMPs as well as how strict they should be, three key aspects must be kept in mind. The first aspect is the nature of the pollution threat. Various NPS pollution sources have very different environmental impacts, as explained in section 3.0. Obviously, facilities or sites





producing hazardous, toxic, or otherwise harmful storm runoff (or groundwater infiltration) have a greater potential to pollute the Estuary, whereas other land uses require less or no BMP control action.

A second aspect is remoteness from the area susceptible to damage. Pollution sources adjacent to the Estuary have a greater likelihood of polluting it and therefore must have greater priority for control. Other areas from which flows can reach the Estuary only after considerable time, either in tributaries or overland flow, will have a lesser priority and require less strict BMPs (or none at all). The allowance for proximity of sources can be accomplished by (1) a narrow buffer strip adjacent to the Estuary periphery and extending up tributaries, within which development will be severely limited and use of fertilizer minimized, and (2) the zone of influence, a broader area inland from the buffer strip, within which standard and special best management practices for control of NPS pollution will need to be implemented in order to protect the Estuary.

The third aspect of prime importance is priority of the area adversely affected by pollution. Besides the Estuary itself, some other waterbodies are especially sensitive or environmentally important to protect for either environmental or public health reasons.

It is important not to neglect any of the key aspects outlined above. In the interest of practicality, a simplified approach is essential. What is proposed is essentially a matrix approach which will lead to one of four alternative conclusions, as follows:

- the facility is environmentally unacceptable and cannot be sited as proposed;
- the facility will require especially stringent (special) BMPs if it is to be allowed;
- the facility will require standard BMPs;
- the facility will require no controls designed to protect the Delaware Estuary.

By evaluation of the aspects discussed above, the following conclusions appear to be reasonable.

Within the zone of influence, standard BMPs should be applicable for most development (Class 2) with special BMPs generally required for facilities considered potentially extra harmful (Class 1). If the area



affected is extra sensitive, the relocation of the development as proposed should be considered. Selection of BMPs can be based on harmfulness of pollutants and area sensitivity, as follows:

<u>Harmfulness</u>	<u>General Use</u>	<u>Areas of Special Sensitivity</u>
Class 1	Special BMPs	Generally not allowed
Class 2	Standard BMPs	Special BMPs (if allowed)
Class 3	None	None

Most sensitive areas, such as wetlands and wildlife refuges, have building restrictions imposed by law. Where exceptions were allowed, special BMPs would be required (for example, if facilities are allowed to be built along the shores of the Estuary). In general, the protection required not only depends upon the location of a facility, but also whether its runoff flows into a sensitive area. Areas of special sensitivity may include natural resource areas designated for protection by local authority, but they need not cover only habitats. If a community has a plan or passes an ordinance establishing a local park or playground, or proposes protection of local resources, that action should be sufficient to require the appropriate level of BMPs for future development projects.

In the interest of protecting the Estuary, the BMP decision need require only the level of NPS protection to be determined, either standard or special. Considerable flexibility should be allowed as to the specific means by which a given level of protection will be obtained, and other local concerns should be considered. For example, if a given housing development requires the standard measure of particulate retention, the decision as to whether or not a wet basin is to be used should balance the extra effectiveness and the aesthetic advantage of a lake against possible mosquito problems and the dislike of some occupants to have ponds so close to their small children. This balance of local concerns and priorities should be left for local decision-makers.

In some areas, such as wild and scenic rivers or habitat of endangered species, stricter standards may be required. Presumably, in the interest of local environmental priorities, various municipalities may require stricter criteria than are needed to protect the Estuary.



## 7.0 ZONE OF INFLUENCE AND AREA STRATEGY

### 7.1 General

As indicated above in Section 3.0, the runoff NPS pollution potentially harmful to the Estuary and its adjacent ecosystems comes partly by overbank runoff but mainly from tributaries and from the upper reaches of the Delaware River itself. It is clear that pollution of any point within the drainage area of the Estuary has some effect upon the Estuary; but it is also clear that the more distant points have a lesser effect.

After considerable preliminary study, a meeting was held at the Delaware River Basin Commission headquarters in November 1991 to discuss the area application of BMP controls. It was considered that this was a question of priority. The areas from which pollution is most likely to pollute the Estuary should be considered to be of higher priority for control. The effect of time of travel on pollution was discussed. A time-of-travel in channel flow makes a verifiable and predictable reduction in BOD and a rapid although only roughly predictable reduction in bacteria. Most other pollutants other than nitrates are affected to a lesser extent. It was brought out in this meeting that heavy metal pollution is materially reduced in passing down a stream, although it was observed that since the metals are conservative they may later be resuspended.

Additional information was given as to the 40-hour travel time on the Neshaminy Creek (almost to Doylestown) and the Repaupo and Racoon Creeks in New Jersey, which like the Chester Creek in Pennsylvania are much shorter. It was mentioned that although TOT cannot be computed on the Schuylkill River by the methods use on the creeks, it would obviously extend much further. It would be reasonable to extend NPS control on the Delaware River above Trenton to less than 40 hours, perhaps to the dam below New Hope.

It was considered that the 40-hour time-of-travel would be used as an illustration, recognizing that a greater or lesser period might be decided upon.

Later, in 1993, the concept of using a tributary drainage basin for the application of BMPs began to be advocated. It was pointed out that all runoff pollution anywhere in the watershed has an effect upon the



Estuary. This viewpoint was related to guidance from the 6217 program of coastal zone controls. This guidance indicated that all pollution from the tributary drainage to the Estuary (below the Morrisville Rapids) would be considered relevant to estuarine pollution. Tributaries upstream of this point were not to be included. However, general provisions of the guidance allow action to be recommended in any case, where such flow materially affects the water quality (which is certainly true for the main stem Delaware).

Obviously, it would be desirable if not essential that the DELEP program and the 6217 program coincide. On the other hand, arrangements to implement this program in Pennsylvania would probably be materially more difficult if the area of control included large areas, particularly in the upper waters of the Schuylkill River, which appeared to the local municipalities to be remote from the Estuary. There certainly is no conflict between the objectives of the two concepts, since the complete watershed approach would have more benefit to the Estuary than the restriction to a zone of influence. If the Coastal Zone Section 6217 Program could be implemented in its entirety at an early date, that would settle the matter; but it would be more practical to consider the DELEP zone of influence as a first phase, which could be extended throughout the larger area later, if the need arose.

## **7.2 Method of Delineation**

There is no standard, established method of delineating such a zone of influence. The matter must be examined on its merits without any established procedures.

If it could be determined that only one particular parameter of pollution was of interest for the Delaware Estuary, the problem would be simplified, as that parameter could be modelled. On the Chesapeake, nutrients are the source of the most immediate pollution problems. However, on the Delaware, this is not the case. Although nutrients are undoubtedly of long-range concern, anoxia from excess BOD has already been very serious, and other substances such as toxics and hydrocarbons may adversely affect biota. Therefore, systems of control must be applicable to NPS pollution in general.





Detailed study may show that in any particular area, the zone of influence is not the best organizing concept. For example, on the Susquehanna River in Pennsylvania the plan to reduce phosphorus in runoff by specified percentages (in order to protect Chesapeake Bay) is based upon priority attention being given to those areas with the greatest pollution potential, which happen to be areas not in the lower part of the Susquehanna River Basin. The zone of influence described in this report provides spatial ordering of NPS control priority subject to supplemental measures, if detailed studies accomplished later show this to be desirable.

In general, the priority of control of NPS pollution should be based on proximity to the Estuary. Principles of water quality modeling are relatively well established, but they are dependent upon the pollutant in question. BOD and bacterial contamination are reduced fairly rapidly with time.<sup>14</sup> Chemical processes of degradation are generally time dependent. Reduction of ammonia is also time dependent, but with a lag.<sup>15</sup> Volatiles are dispersed partly with time but also with turbulence and shallowness of flow, which would result in more rapid dissipation in small streams.<sup>16</sup> Nutrients are absorbed by infiltration and by plant uptake during flow, which is also greatest in small streams. A great deal of particulate matter settles out in pools, where it has a chance to biodegrade or be otherwise dissipated in time; but ultimately the remaining particulate matter is moved downstream again, usually by high discharges.

It appears that for NPS runoff pollution in general, the best gauge of importance of control from the Estuary viewpoint is time-of-travel, with some indication that, for a given time-of-travel, small flows are more effective in reducing pollution than large flows.

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<sup>14</sup> BOD is reduced in accordance with the well established formula; bacteria are reduced by processes which are irregular and not calculable, but fairly rapid.

<sup>15</sup> Ammonia is reduced with a time lag because the bacteria which act upon the ammonia are slow growing and take time to produce an abundance sufficient for rapid deterioration.

<sup>16</sup> The rapidity of a volatiles evaporation depend upon the characteristics of the chemical and also upon the processes of turbulent flow, which bring the water into greater contact with the air if the stream is shallow and is turbulent because of its slope. [Also in accordance with wind velocity].



### 7.3 Origins of NPS Pollution and Control

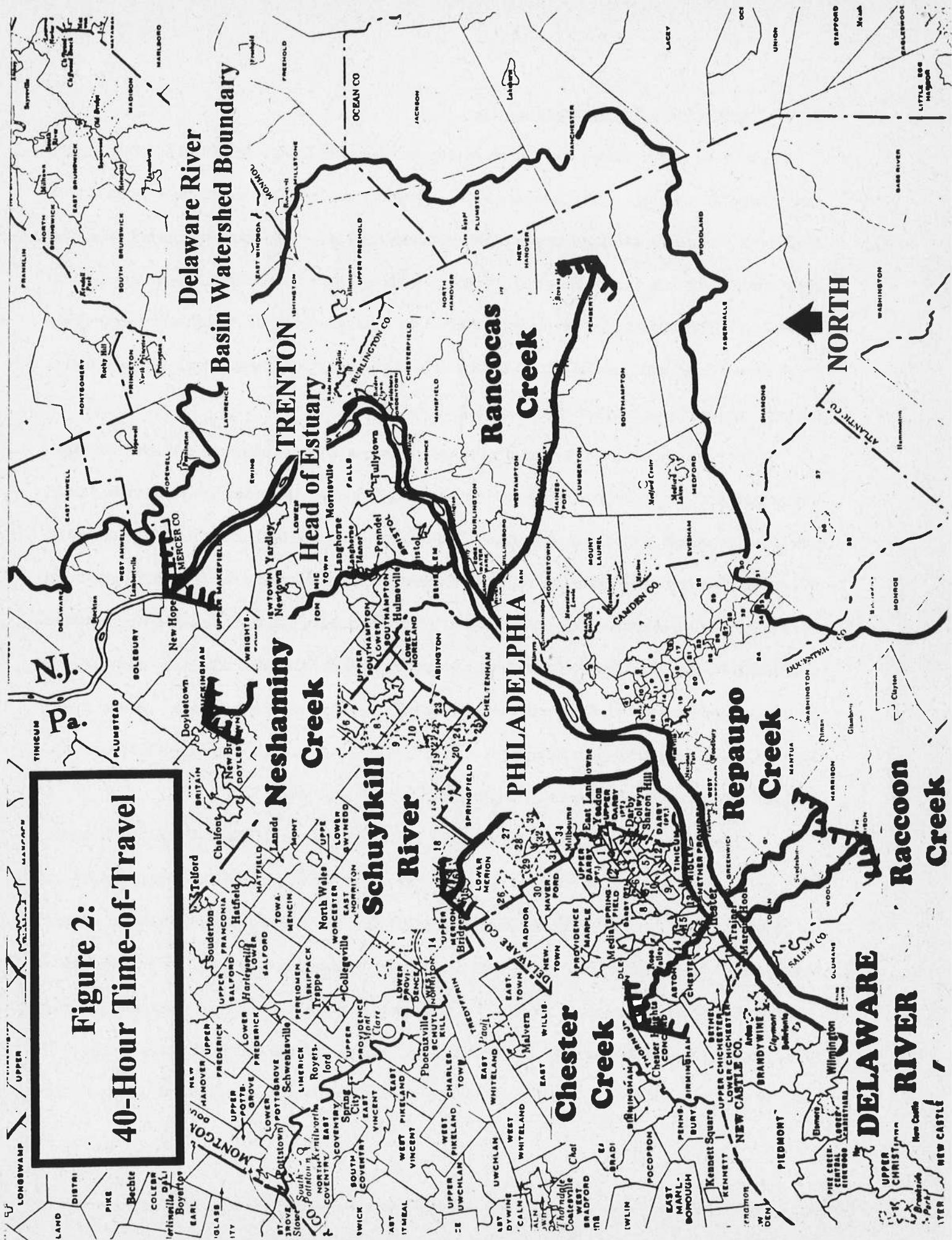
Part of the runoff into the Estuary occurs by sheet flow across the Estuary shores, but by far the greater part comes from upstream on the Delaware River, from tributaries, and from intermittent overland flow channels. It is desirable to provide a substantial degree of reduction of pollution from this channel flow. The upper portion of the main stem Delaware River and its tributaries are so remote that the mere lapse of time during flow will be sufficient to effect the desired reduction in pollutant content. For immediate areas closer to the Estuary (in terms of time-of-travel), BMPs can be imposed which will make the desired reduction in pollution content (in addition to buffers along the edge of the Estuary).

The area of the zone of influence is defined by the time-of-travel of pollutants to reach the Estuary. This is computed from the slope of each watershed and other hydrologic and hydraulic characteristics which reflect the uniqueness of each stream and creek. The concept is based on the fact that many NPS pollutants will be attenuated or reduced as they are volatilized, absorbed or chemically changed during the time-of-travel so as to reduce their impacts on the Estuary waters. Within the zone of influence, time-of-travel in streams is insufficient to protect the Estuary and land use management controls are needed. Controls outside the zone of influence are considered to be of lesser priority for NPS protection of the Estuary unless special studies show the need of a supplementary program. A 40-hour time-of-travel (at mean rates of flow) is proposed as the basis for determining the zone of influence in each tributary watershed.

A preliminary approximate determination of 40-hour time-of-travel for certain tributaries is shown on Figure 2. On Chester Creek in Pennsylvania, the 40-hour time-of-travel would extend about 9.2 miles, and on Rancocas Creek in New Jersey it would extend over 20 miles. However, on a hypothetical small channel draining two square miles of area, with a slope of .0005, the distance would be only 2.5 miles. The special significance of the hypothetical small channel is as follows. In any normally drained topography, drainage does not proceed long in sheet flow but aggregates into intermittent channels from which it flows either directly into the Estuary or into significant tributaries. Where no tributaries are identified, the hypothetical



**Figure 2:**  
**40-Hour Time-of-Travel**



small tributary, 2.5 miles long, represents the minimum distance width the zone of influence should extend from the Estuary limits or outward from a significant tributary near its mouth. At any intervening point on the significant tributary, the width of the zone of influence outward from the tributary may be assumed to vary linearly with distance, so that the theoretical time-of-travel from any point on the boundary to the tributary and down the tributary to the mouth would total 40 hours.

In order to avoid needless expense for very detailed computations and mapping in areas between streams, approximations should be made by using highways, roads, and other physical landmarks as part of the boundary. An example is shown in Figure 3.

#### 7.4 Special Cases

Certain special cases would need consideration in implementing a time-of-travel concept for the zone of influence. First, a large lake on a tributary, such as Union Lake on the Maurice River in New Jersey, would provide sufficient detention time to obviate the need for a zone of influence above that point (as far as protection of the Estuary is concerned). The evaluation would need to be made for each case.

Second, computations would be needed to outline the zone of influence on the main stem of the Delaware above Trenton. It would be undesirable to implement restrictions on areas too distant from the Estuary. For practical reasons, somewhat less than 40-hour time-of-travel will probably be used. Tentatively, the dam below New Hope, Pennsylvania has been designated as the limit.

Third, if later studies should show that special controls for nitrates are required, some different approach would be used. The detention and settlement of stormwater runoff, which is the usual BMP for reducing NPS pollution, is almost completely ineffective for nitrates. Where and by what means nitrates would be controlled cannot be determined by consideration of the zone of influence.

Lastly, it should be noted that there would also be some need for special controls of NPS pollution in the case of developments served by storm sewers. The time-of-travel in a closed storm sewer would be







neglected, as far as concerns reduction of pollution, in the delineation of the zone of influence or its subsequent modification.

## **8.0 RELATED ON-GOING PROGRAMS AND COORDINATION**

### **8.1 General**

The potential pollution of the Delaware Estuary is a matter of concern to the Federal government, including the EPA and other agencies; to the governments of the three states; and to the many county and municipal governments involved. In attempting to develop the optimal solution, existing forms and procedures of government are not considered inviolable but it is assumed that options preserving the existing basic structure of government would be preferable, barring a good reason for change. Rather than considering theoretically the ideal institutions to implement an Estuary plan, what is needed is an approach requiring the least modification of basic laws and institutional arrangements in the three states. It is considered necessary that different portions of the Estuary region all contribute to the program on an equitable basis; but if the basic requirements can be met, the uniformity of the various organizations and procedures between states is considered to be of secondary importance.

### **8.2 Intrastate Coordination**

Within each state, some means of interagency coordination with on-going programs will be necessary. The initial arrangements will need to be verified and adjusted as time passes. Although general responsibility for implementing the Clean Water Act rests with state environmental departments, the arrangements for controlling NPS from agriculture and from soil and erosion control in general remain with conservation districts and departments of agriculture (in Delaware DNREC), as mentioned earlier. Similarly, control of the runoff from highways remains with departments of transportation (in Delaware DNREC), but can be made subject to meeting criteria. BMPs will probably be implemented mainly through municipalities or with dual controls, including, where required, a coastal zone permit. Although an interagency agreement on criteria will start the operation out on a good footing, changes and adjustments will inevitably be needed which will require



agreement and perhaps compromise between the agencies. For purposes of coordination, each state will need either a designated agency, a council, or a formalized interagency committee responsible to the Governor's office. It does not appear necessary that the new coordinating entity should exercise operational or administrative functions, but it will certainly need to exercise oversight.

Within a state, there are at least four types of organization by which state-wide coordination of the DELEP could be implemented. The first would be a coordinating council representing heads of participating agencies. The second would be a new Delaware Estuary Agency, responsible to the Governor, with coordinating and oversight authority over the other agencies. The third would be the same except that the Delaware Estuary would be given formal authority to direct the other agencies in matters pertaining to the Delaware Estuary. The fourth would be to select a lead agency of state government which would be given coordinating and oversight authority over other agencies.

Any one of these four alternatives, if selected by the state, could provide effective coordination and oversight for carrying out the DELEP. It is not important that the three states have the same coordinating organization as long as there is an agency responsible for effectively carrying out agreed policies and for dealing with other states on interstate matters.

### 8.3 Interstate Coordination

Similarly, some form of interstate coordination and oversight will be required. This will entail integrated reporting of implementation procedures, progress reports, conduct of further research, transfer of technology, standardization of educational programs, and (as possible) coordination of standards as well as consideration of further measures beyond those initially undertaken. For the start of the program, it is assumed that the DELEP Management Committee will initiate the action. An interstate agreement covering objectives, criteria and legislation will be required. An interstate coordination planning and oversight capability exists under the DRBC compact.



#### 8.4 The Basic Organizational Framework

In summary, the basic arrangements which appear to be essential are as follows:

1. With tri-state agreement, establish criteria and performance standards that would be mandated for use by local governments and state agencies.
2. Establish an interstate coordination, planning, and oversight capability.
3. Establish a state top-level coordination and oversight agency for each state and provide for state funding.
4. Zones of influence will need to be delineated for each watershed.
5. Local land use planning and controls, including BMPs, subject to state-level coordination, will be required.
6. Most agencies will be operational in substantially their present form, including:
  - a. Section 402p, industrial, county and urban.
  - b. Conservation Districts and other agricultural agencies.
  - c. Coastal Zone Management.
  - d. Wild and Scenic Rivers.
  - e. State natural resources agencies

#### 9.0 COSTS AND FUNDING

This Delaware Estuary Program is designed to accomplish the maximum amount of pollution control for the economic costs involved. This is done by concentrating attention upon new development, since it is generally much cheaper to reduce runoff pollution by taking preventive measures when a development is built than to incorporate remedial measures after it is completed and in operation.

The primary BMPs recommended relate to stormwater management and there are two cases which greatly affect the costs involved. In the first case, the area involved has mandatory provisions for stormwater management requiring that each new development require detention of runoff from major storms in the interest of flood hazard reduction. In this case, all that needs to be done is a somewhat longer detention of runoff from smaller storms (one year frequency or less). This adds nominally to the cost of the detention facilities and has the incidental affect of contributing to reduction of flood peaks further downstream.





The second case is where retention of large storms in the interest of flood hazard reduction is not required. This is sometimes the case, in streams flowing directly to the Estuary when there is no substantial developable floodplain downstream, but more often it is simply because neither the state nor the municipality has made such a program mandatory (as currently is the case in most parts of New Jersey and Pennsylvania). In this case, the smaller water quality detention facilities required for runoff pollution control must be built and considered a cost of the DELEP. Of course, the detention basins required are much smaller than those required for normal stormwater management and may often be provided by swales or other at-site facilities, but the costs will still be greater than if the detention is provided as an adjunct to basins required by a stormwater management plan.

Experience in New Jersey has indicated that the costs incurred by developers are not such as to hamper development. However, there remain certain other costs which must be covered. First, a survey of the zone of influence would be necessary and it would need to be done by the states in order to ensure uniformity and reduce possibilities of litigation. Approximate costs would be: Delaware - \$250,000, New Jersey - \$500,000 and Pennsylvania - \$500,000. Second, municipalities would need to draft and establish ordinances at a cost of perhaps \$2,500 per municipality. Third, the state itself would incur costs for staffing and implementing an agency (or part of an agency). Fourth, there would remain the costs to municipalities for reviewing the necessary plan submittals. This can be taken care of by charging a fee to the developer for the necessary review of plans based upon actual costs of the staff time (or consultant fee) necessary. Alternatively, the municipality may provide funding from other sources.

In summary, each state, in order to implement the program, would need to provide for delineation of the zone of influence and the staffing of a coordinating agency. Either the state or the municipalities would need to absorb the costs of the necessary ordinance revisions. The municipality would also need to establish a fee schedule to defray the costs of reviewing the plans.



## 10.0 STRATEGY SUMMARY

The strategy relies primarily on land use management tools to reduce NPS pollution to the Delaware Estuary by reducing pollution from new development through improved planning and use of best management practices and by providing buffer strips to set back development and filter runoff. The program will not only protect the Delaware Estuary, it will have significant benefits to local streams by reducing runoff pollution which would otherwise occur and providing small stream corridors by means of buffer strips.

It was concluded that the Delaware Estuary, in addition to local streams, needs protection against NPS pollution from future land development and that an immediate technology-based program can be established that is cost-effective for rapid implementation. It would generally cost much less than approaches designed to reduce runoff pollution from existing facilities. This program can be implemented at the local level through local authorities as part of a developer's site plans (changed to accommodate BMPs and buffers) and through changes in local comprehensive planning and zoning. State actions involving guidance, criteria, procedures, modifications to state laws and regulations for water quality management and permitting, and infrastructure planning will also be required.

The strategy includes control of NPS pollution by water quality control of stormwater runoff. Two grades of control are needed: standard BMPs, which will remove the greater part of particulate contaminants, and special BMPs, which will remove a higher proportion. The decision as to whether the standard or special BMPs are applicable to a given new development depends both upon the environmental sensitivity of the area affected and upon the relative environmental harmfulness of the particular type of facility being built. These BMPs for protection of the Estuary should be applied in the zone of influence.

Within the zone of influence, developers would be required to use specified BMPs and buffer strips. Much of the control would be handled as routine site-development activities such as modified landscaping with BMPs (detention basins, swales, etc.). Buffer strips are recommended for two purposes: (1) to minimize NPS pollution in the immediate proximity of the Estuary and its tributaries, and (2) to protect sensitive areas.



The buffer strip is essentially a site plan set-back within which new construction will not be allowed except for water-based activities, variances, rights-of-way, etc., and which will include an unfertilized vegetative filter strip in any regrading plan.

Two ways to provide some protection of environmentally sensitive areas were outlined. The first is the establishment of minimum buffer strips (Section 4.0) along the shore of the Estuary and its wetlands, including tidal portions of tributaries. The other is by controlling land use management (Section 5.0) to minimize development in or adjacent to sensitive areas. Both aspects should be considered in land use management.

In addition to controls over developers by local land use management, equivalent controls need to be imposed by the state through state permit programs and also in the state's construction of its own infrastructure such as highways and water and sewer systems. Key elements of the strategy are explained in preceding sections.

Although pollution anywhere within the watershed of the Delaware may have some effect upon the water quality of the Estuary, pollution from more remote areas is likely to be dissipated before arrival in the Estuary. As a result, a zone of influence is proposed, based on time-of-travel of flow to reach the Estuary. A 40 hour time-of-travel along stream channels and tributaries to the Estuary is considered appropriate to define the zone of influence (see Figure 2 for examples of the approximate upper stream limit of the zone on selected creeks and rivers). This approach provides a definition of the area to be managed based on the concept that time-of-travel attenuates NPS pollutants during their travel to the Estuary. Within the zone of influence, modified local planning and zoning, buffer strips and BMPs would be used to protect Estuary water quality. These zones of influence would be delineated (mapped) for each watershed above the head of tide, thus limiting the area to be managed and improving the likelihood of public support and acceptance of the BMPs by limiting the area of their application.



## 11.0 LONG-TERM MANAGEMENT

It has been made clear that the land use management/NPS control strategy outlined in this report is an action program designed to curb the environmental deterioration now underway from runoff associated with new development. Comprehensive scientific analysis of the occurrence of the various pollutants, their fate, and affect upon biota and habitat will ultimately provide much deeper scientific insights. This may result in findings, for example, that more specific controls of certain toxics or of nutrients may be required or that extensive controls may be required to reduce pollution from existing facilities by means other than land use controls. Therefore, the overall strategy proposed is to initiate the proposed action but to continue necessary monitoring and research to fully develop the complete picture.







## **PART II: PENNSYLVANIA DEMONSTRATION PROJECT**

### **1.0 INTRODUCTION**

In planning for the NPS Pollution Control Demonstration Project in Pennsylvania, three municipalities in Delaware County were selected: Aston Township, Chester Heights Borough and Middletown Township. These municipalities are far enough from the Estuary to illustrate the diminishing of concern about the Estuary with distance from it and also the practical problems of dealing with delineating the zone of influence within a municipality. Careful study of Pennsylvania legislation concerning land use planning and stormwater management was required in order to show the special problems of implementing a program to control NPS from new development in Pennsylvania (as compared to Delaware and New Jersey). Finally, detailed study was required of the ordinances of the three municipalities and there was discussion with municipal representatives as to action which would be required by the program and its anticipated acceptance by the public.

### **2.0 SCOPE OF PROGRAM**

#### **2.1 Municipalities Planning Code**

The implementation in Pennsylvania of the recommended Land Use Management NPS Control Strategy would involve changes in two different activities: land use planning and requirements for best management practices in new development. As one option, this could be accomplished through changes in two state laws: the Municipalities Planning Code and the Stormwater Management Act.

The Municipalities Planning Code in Pennsylvania leaves authority highly decentralized to municipalities and municipalities throughout the state rely on these provisions so strongly that it is considered politically unwise to suggest any revision, even though it would be restricted in its effect to the Delaware Estuary area. Therefore, this option was not considered further.



## 2.2 Wildlife

Another issue that had to be faced was whether the program recommended would be restricted entirely to NPS pollution control or would incorporate special provisions for the benefit of wildlife. In developing the tri-state strategy as a whole, a prime purpose was protection of wildlife. The objective of controlling NPS pollution in the Delaware Estuary is largely related to protection of wildlife including fish, horseshoe crabs, and the international flyways. The NPS pollution control program herein recommended would require establishment of buffer strips along the shores of the Estuary and these buffer strips would undoubtedly include large amounts of sensitive habitat. Consideration was given to including in the regulations for control of activities in buffer strips special provisions for surveys and protection of wildlife. However, detailed plans for protection of wildlife in the Delaware Estuary are being prepared by another committee with estimated completion in 1995. Because of this pending action, it was considered by the Advisory Committee that inclusion of specific wildlife provisions in this program would be premature. The NPS control provisions would provide a major incidental benefit to wildlife by restraining construction and development in sensitive habitat areas of the buffers but no additional specific provisions to protect wildlife are included in the program.

## 3.0 STORMWATER MANAGEMENT ACT

### 3.1 Scope of Act

Since the recommended best management practices for control of NPS pollution consist largely of requiring water quality provisions in stormwater management, the revision of the Stormwater Management Act would appear to be the most obvious means of implementing the program. The Pennsylvania Stormwater Management Act<sup>17</sup> is primarily directed at controlling accelerated runoff due to development with no requirements directed at improving the water quality of runoff. Implementation by municipalities is encouraged by guidelines and by model ordinances. However, the primary means of implementing stormwater management in Pennsylvania is by way of stormwater management plans prepared by counties. Although the

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<sup>17</sup> October 4, 1978, PL684 No. 167, 32 PS 680 et seq.



act appears to contemplate that all counties will prepare such plans, in practice this is not done until state appropriations become available to pay for 75 percent of the costs of preparing the plans. This has not been done in the majority of watersheds.

### **3.2 Details of Revision in the Act**

If it were so decided, the Stormwater Management Act could be used to authorize completion of this program by some major modifications as shown in Appendix 1. The more important modifications are summarized below.

- Include prevention of water quality degradation as a purpose of the act (Sections 2 and 3 of the act).
- Require county and local authorities to take appropriate measures in land development activities (Section 3 (4)).
- Define primary zone of influence of the Delaware Estuary (Section 4).
- Require all counties with watersheds within the primary zone of influence to prepare watershed stormwater management (SWM) plans to include provisions of SWM regulations, and if sufficient funding is not available for a full study, to implement a requirement for BMPs on new development within a year (Section 5d).
- Require that the Pennsylvania Department of Environmental Resources (PADER) designate watersheds within the primary zone of influence based upon 40-hours time-of-travel, which the department would determine by survey, and that the department issue regulations requiring BMPs in these watersheds. Within the zone of influence, require municipalities to issue permits for new construction and authorize them to charge a fee to developers representing the average cost to the municipalities of implementing such provisions (Section 14 a (13)).
- Authorize appropriations to cover the initial departmental survey of the zone of influence, expenses of municipalities in enacting required ordinances, and other expenses required by the Act.

### **3.3 Implementation and Practicability**

Implementation of the revised Stormwater Management Act would be effected by mandatory regulations applicable to all watersheds within the zone of influence. A draft of appropriate regulations is given in Appendix 2. In effect, they would be quite similar to regulations in the State of Delaware, which are mandatory, and they are also quite similar in most respects to regulations of the State of New Jersey which,





however, are not mandatory unless imposed by municipalities. However, in Pennsylvania, stormwater management is designed for flood retardation and soil erosion control exclusive of water quality control, and even these provisions are not mandatory unless imposed voluntarily by the county through watershed SWM plans or voluntarily by municipalities. Therefore, in Pennsylvania, the requirement for mandatory water quality control in land use management would be such a wide departure from existing practice that the Ad Hoc Committee (advisors to the Demonstration Study) considered it preferable to implement the program through separate legislation, clearly indicated as applicable only to the Delaware Estuary region.<sup>18</sup> For this reason, the explanation of the best management practices recommended for the regulation is given under the Delaware Estuary Protection Act in the following section.

#### **4.0 DELAWARE ESTUARY PROTECTION ACT**

##### **4.1 Scope**

This act (Appendix 3) and its accompanying regulations (Appendix 4) would provide for implementation of the tri-state Delaware Estuary NPS Control Program, which is the subject of this report. In the event of the Delaware Estuary Program being later extended beyond the provisions recommended in this report, this separate act would provide a convenient basis for amendments required to implement the later parts of the program. Implementation of this program would largely arrest the continuing increase in NPS pollution due to development which threatens the water quality and environmental state of the Estuary.

##### **4.2 Nature of Act**

Within specified areas adjacent to the Delaware Estuary known as the zone of influence, new development and redevelopment would be required to implement BMPs which would remove the greater part of the additional particulate runoff pollution which the development would otherwise release into the Delaware Estuary. Within the designated areas, this Act would modify land use planning and stormwater management

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<sup>18</sup> This would follow the precedent for special legislation regarding the shore of Lake Erie: Act of May 13, 1980 (No. 48)(32 P.S. §§ 5201-5215).



programs. To the extent that the new program differs from the provisions of existing regulations, the provisions of new regulations under this Act would prevail. In situations where both water quality control under this Act and further stormwater management planning would be required, and it is impracticable to combine the two, the water quality provisions would be implemented without delay as an early phase, and any subsequent stormwater planning or implementation of such plans would be prepared so as to be consistent.

This Act would be implemented by an agency of the Commonwealth, referred to as "the Agency," to be designated by the Governor.

Sections 1 through 4 provide the usual purpose and definitions. Sections 5 and 6 of the Act would require a survey to be made by the Agency to determine the watersheds and portions of watersheds from which runoff may reach the Estuary in less than 40 hours. The Agency would designate this area as the zone of influence and it would require the Agency to issue mandatory regulations requiring BMPs on new development and redevelopment within this area.

Section 7 would require creation of buffer strips along the shores of the Estuary itself and of tributaries within the zone of influence. Within these buffer strips, special land management and BMP restrictions would be required as outlined in regulations to be issued.

Section 8 would require that municipalities issue permits for development and redevelopment within the zone of influence and would authorize the charging of a fee for such permits.

Section 9 would provide for coordination between BMP requirements under this Act and stormwater management plans of the counties.

Section 13 would appropriate funds to pay for the initial survey by the Agency to determine the limits of the zone of influence, to allow for reimbursement to the municipalities for the initial expenses of evaluating required ordinances, and to provide for other expenses of the Agency in implementing the Act.



#### **4.3 BMP Regulations Delaware Estuary**

The regulations which would be required for implementation of the proposed Delaware Estuary Protection Act are given in Appendix 4.

Sections 3 and 4 of the BMP Regulations would require municipal and county authorities to implement measures for new construction to control water quality degradation from storm runoff, describe coordination of such measures with planning activities under the Stormwater Management Act, and require implementation of provisions of these regulations as an initial step in situations where funds for a more comprehensive study are unavailable.

Section 6 states the criteria for inclusion of a project in the program (an addition of 13,000 square feet of impervious surface). This section would require that construction by counties and various agencies within the Commonwealth also comply with provisions of these regulations.

Section 7 would establish the 40-hour time-of-travel runoff criterion for determining limits of the zone of influence with a modified criterion for the main river upstream of Trenton.

Section 8 describes Best Management Practices (BMPs) with two grades of efficacy, standard and special. The BMPs are described first in terms of dry detention basins (extended detention) with provisions for use of various equivalent alternatives such as wet basins and infiltration facilities. Provisions are outlined for regional approaches which could provide more cost-effective solutions under appropriate conditions. Limitation of minimum outlet diameter for very small basins is indicated. Restrictions on placing detention basins in floodplains is outlined. A method of selection of BMPs is established giving consideration to the degree of the inherent harmfulness of the runoff from the facility in question and also the inherent environmental sensitivity of the area. Special provisions of BMPs and limitations on location of facilities in buffer strips are provided.

Section 9 outlines measures necessary to ensure continued maintenance of runoff control facilities. It would require inspection and follow-up by the municipality and would allow maintenance of multiple



ownerships by owners associations. However, it would provide for ultimate responsibility to be retained by the owners with the municipalities empowered to carry out the work and charge it to the owners in the event of continued neglect.

#### **4.4 Initial Appropriations and Funding**

In addition to staffing and administrative expenses of the new Agency, there would also be two non-recurring expenses the Agency (or the interim directing staff) would need to conduct the survey of the boundaries of the zone of influence. This would have to be done with sufficient accuracy to resist lawsuits by landowners wishing to free their land for unrestricted development.

Secondly, it would be desirable to make grants to municipalities to cover costs of making the necessary changes to ordinances. This would probably average about \$2,500 per municipality. The costs to municipalities of administering the BMP controls can be covered by imposing a fee on permits for development and redevelopment projects.

#### **4.5 Other State Action**

In addition to establishing and staffing the Agency for implementation of this program and making a survey of the zone of influence, certain other actions would be necessary in Pennsylvania, including the following:

- Provide for participation in interstate coordination.
- Intrastate coordination with other state agencies regarding observance of BMPs in their construction programs.
- Oversight of county and municipal participation.
- Budgets, education programs, continued research and program evaluation.





## **5.0 REQUIREMENTS FOR THREE MUNICIPALITIES**

### **5.1 General**

The DELEP demonstration project for Pennsylvania involved Aston Township, Chester Heights Borough, and Middletown Township in Delaware County. They are all far enough away from the Estuary to illustrate the degree of remoteness expected to characterize most of the zone of influence. Because of the decentralized nature of municipal government in Pennsylvania, there is considerable diversity among applicable ordinances, which is expected to be true in general in other parts of the Estuary watershed. The three municipalities were considered individually. In each case, revisions that would be necessary to implement the program were proposed and discussed with representatives of the respective municipalities. These modifications to existing subdivision and land development ordinances and/or stormwater ordinances are presented in this chapter.

Although it is assumed that the municipal ordinance revisions outlined in this report would be undertaken only after a decision to proceed with the program and the time required by the Commonwealth and the other states to prepare necessary legislation and regulations for a complete program, an immediate interim phase using guidance rather than mandatory regulations and voluntary local implementation is also feasible. For the mandatory program, these ordinances would be issued within the context of the new regulations (or guidance) and clarification would be available on various technical points so that all details would not have to be spelled out in each ordinance. The interim, voluntary program can be implemented immediately through the Pennsylvania "Guidance Document."

The substance of proposed revisions is given in the following sections for each municipality.

### **5.2 Delineating the Zone of Influence**

Computations were made by The Greeley-Polhemus Group, Inc. of the 40-hour meanflow time-of-travel on Delaware Estuary tributaries passing through or adjacent to the three municipalities. Rough



estimates were made of time-of-travel of storm runoff of smaller streams and overland flow during runoff conditions. Delineation of boundaries was made following roads, levees, or other features distinguishable on U.S.G.S. quadrangle maps (see Figure 3 in Section 7.3 of Part I). It is assumed that the municipalities would have available delineations of the zone of influence made by the Commonwealth.

The following sections provide actual recommended changes to ordinances and plans in the demonstration communities. A typical community may have several ordinances and plans that could be amended to include the nonpoint source control objectives:

- Subdivision and Land Development Ordinance
- Stormwater Management Ordinance
- Zoning Ordinance
- Comprehensive Plan

Because the existing ordinances of these communities are lengthy and are mostly irrelevant to the purposes of this report, they are not presented here; only the changes are presented.

Two model ordinances are presented in the Pennsylvania guidance document, Guidance for Voluntary Local Government Implementation of Nonpoint Source Pollution Control: Protecting Local Streams and the Delaware Estuary, The Greeley-Polhemus Group, Inc., June 1994.

### **5.3 Aston Township (Recommended Changes to Ordinances and Plans)**

#### **5.3.1 Subdivision and Land Development Ordinance**

This ordinance provides requirements for subdivision and land development. Several changes would be necessary to achieve control of stormwater quality from new development or renovations.

Add to purposes:

*To provide by means of streamside buffer strips and best management practices in handling stormwater for the reduction of pollution in streams from new development with the zone of influence.*

Under Stormwater Management Plan add:



*Classify degree of environmental harmfulness of the type of facility proposed. Check whether affected by streamside buffer strips (see 1242.10 below). Determine whether "standard" or "special" degree of best management practices is required (Ordinance 644).*

Add new paragraphs as follow:

*For the protection of the Delaware Estuary and of local streams, both as regards water quality and habitat, buffer strips of 50 feet width measured from the low flow channel are established along certain streams.*

*The buffer strip is essentially a site plan set-back within which new construction will not be allowed except where allowed by variances for water-based activities and for essential construction such as bridges. The 20 feet adjacent to the stream may be retained in natural vegetation, unfertilized, or it may be replaced by a graded grass filter strip upon which the land holder is encouraged not to place fertilizer.*

*Where small building lots have been given preliminary approval, prior to 1 July 1992, the land reserved for a buffer shall not exceed 40 percent of the depth of the lot [e.g., for an 80-foot deep lot, the buffer strip would be only 32 feet in width].*

*Special requirements for drainage of storm runoff through buffer strips are covered under Selection of BMPs (Ordinance 644).*

### **5.3.2 Aston Township Ordinance No. 644 (Stormwater Management Design and Best Management Practices)**

This ordinance provides for stormwater management BMPs for runoff retardation in the interest of flood control. It may be adapted to purposes of the Delaware Estuary Program by changes as follows.

Insert revised statement of purpose as follows:

*This ordinance covers two interrelated programs. Stormwater management is a program which reduces the flooding downstream caused by the development process. Best Management Practices (BMPs) as used in this regulation refer to measures taken to reduce nonpoint source pollution from runoff. They are usually provided by detention basins used for stormwater management but may be provided by other means.*

Under runoff control measures (Specific Design Standards, No. 19): Delete the words "and quantity" from the criterion for runoff control. In item "c," add "infiltration basins" as acceptable alternatives. Under conditions for ground water recharge add "and if it has been verified that the runoff quality expected will not contaminate the ground water."



The requirement for soils testing and certification should include a review of the likelihood of ground water contamination. An item concerning planning should be added as follows:

*The planning of runoff control devices on a watershed basis rather than site-by-site is usually advantageous and is encouraged. However, the Township Engineer should be consulted regarding the problems of implementing such a system.*

Two items on design of outlets should be added:

*The design approach to meet both the water quality and the flood control requirements is to provide a lower small outlet well protected by trash racks to handle releases for the smaller storms (less than the water quality design storm specified under Runoff Control Measures, Section 22a). At higher elevations, larger flood control outlets and emergency spillways are provided.*

*If for small facilities, the indicated size of the lower outlet to obtain the required detention time is less than two inches in diameter, the outlet should be sized at two inches and the time of detention reduced accordingly.*

Insert a new section as follows:

#### *Best Management Practices for Control of Pollution (BMPs)*

*(1) General - The best management practices specified are designed for the removal of the greater portion of particulate pollution from stormwater runoff. The most important particulates removed include heavy metals, hydrocarbons, sediment, bacteria, and some forms of phosphorus. These best management practices are applicable to all improvements which will add at least 15,000 square feet of impervious surface. These practices require detention and slow release of runoff from the numerous small storms which carry most particulate pollution, while control of the large storms is provided in the interest of control of floods.*

*There are two levels of BMPs, standard and special. The selection of applicable BMPs is covered in the following section. These BMPs are technology-based; that is, although their objective is improved water quality, the BMPs are designed in terms of required structures and/or practices not mathematically related to water quality criteria. The required BMPs are described first in terms of dry detention basins (extended detention) followed by enumeration of alternative measures of accomplishing an equivalent effect.*

*The basic method is described in the ASCE/WPCF<sup>19</sup> manual of practices ASCE No. 77, 1993, "The Design and Construction of Urban Stormwater Management Systems." It consists of prolonged detention of the relatively frequent smaller storms allowing particulates to settle with provisions for necessary flood control retention of the runoff from infrequent, large*

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<sup>19</sup> American Society of Civil Engineers and the Water Pollution Control Federation (now known as the Water Environment Federation).





storms. Similar methods are described in "Controlling Urban Runoff" by the Metropolitan Washington Council of Governments. In the event that flood control retention of larger storms is not to be undertaken concurrently, the detention of runoff from smaller storms is to be required nonetheless. The selected small storm chosen for prolonged detention is called the "water quality design storm". For standard BMPs, the "water quality design storm" is a one year frequency 24-hour storm or, alternatively, a storm of 1¼ inches occurring in two hours. The water so impounded is to be 90 percent released in a period of 18 hours for residential development and 36 hours for non-residential development.

For special BMPs, the water quality design storm is a one year frequency 24-hour storm and the 90 percent release time is 48 hours.

(2) *Detention Basins in Floodplains* - No detention basins will be built in the floodway except for those on-stream. Detention basins elsewhere in the floodplain (the flood fringe) will not be built without a detailed engineering analysis to verify adequacy of functioning during floods.

(3) *Basin Plans and Regional Facilities (BMPs)* - Usually the requirements for BMPs are applied separately to each development. However, a drainage basin planning approach can often provide an overall plan including at-site and regional facilities in a combination which reduces costs to individual developers while still achieving the desired results. In regional plans, particular care must be taken for provisions of facilities maintenance.

(4) *Alternatives (BMPs)* - Alternatives to dry detention basins include wet basins and infiltration basins which, if they meet requirements specified above, provide a higher degree of efficiency than dry retention basins and can be accepted as meeting provisions of special BMPs (provided the permanent pool of the wet basin is at least equal in volume to the water quality storm runoff). Infiltration basins are only acceptable in cases in which it has been determined that infiltration of the runoff will be acceptable for ground water quality.

Various BMPs other than detention can meet the designated requirements, subject to an engineering examination in order to verify the equivalence. Various at-site provisions such as swales, grass filter strips, dry wells, roof-top storage or source controls of pollutants, above or in combination with some provision of retention, can provide effective results.

(5) *Selection of BMPs* - It is clear that BMPs for runoff pollution control should not be applied across-the-board, but that the degree of control required depends on both the inherent harmfulness of the facility in question and any special sensitivity of the area affected by the runoff. A harmfulness index of stormwater runoff, classified by origin, may be summarized as follows.

New developments of Class 1 harmfulness are those inherently likely to contribute to runoff pollution. Proposed commercial and industrial facilities shall be considered Class 1 unless it is shown that impervious coverage will be below 50 percent, or that the type of coverage and low vehicle use (such as warehouses), will assure relatively uncontaminated runoff, and that the development will not contribute any inadequately treated wastewater or effluent. Housing developments with density of less than one third of an acre per housing unit, gas station, state and county highways, and shopping centers are also Class 1.



*New commercial, industrial or housing developments excluded from Class 1 by the provisions of the preceding two sentences shall be Class 2. In cluster housing, the classification of the "cluster" as Class 1 may be compensated for by separate classification of the surrounding portions of the project. For general classification purposes, the harmfulness index provides a useful guide to the environmental effects of any proposed land use when considered with respect to environmental sensitivity of the area affected downstream.*

*Class 1 new developments as a minimum require special BMPs throughout the Primary zone of influence. Class 2 new developments generally require only standard BMPs unless located within a half mile of a streamside buffer strip established by this program, in which case special BMPs are required. For state or Federal designated sensitive areas, restrictions either in or outside the areas will be as required by state or Federal law.*

*Class 1 new developments shall not be built within a half mile of a streamside buffer established by this program unless allowed by variance and after submission of an engineering analysis including provisions for minimizing any pollution from either runoff or waste water. Such provisions shall be made a condition of the permit.*

As regards maintenance of facilities (Section 22, changed to 13), the last sentence should be deleted and the following added:

*In the event that the property is transferred to multiple ownerships, an owners association may be formed to carry out the maintenance for the entire development; but if there are uncorrected deficiencies, the various owners will be notified and after 60 days notice the township will carry out the work and the owners will be billed in amounts pro rata with the assessed valuation of their respective properties or other basis mutually agreed upon by the owners concerned to reimburse the township for expenses in correcting the deficiencies.*

### **5.3.3 Aston Township Zoning Ordinance**

This ordinance would require only the addition of a new subparagraph as follows:

#### *Restriction on Location in or Adjacent to Streamside Buffers*

*Most forms of new construction are not allowed within streamside buffer strips established by the Subdivision and Land Development Ordinance. In addition, location within a half mile of these buffer strips of forms of development most apt to create pollution (Class I) is limited as specified by that ordinance.*

### **5.3.4 Aston Township Comprehensive Plan**

To the purposes specified, add:

*Site new development so as to minimize runoff pollution of local streams and the Delaware Estuary.*



To the general strategies specified, add:

*In the design of new development, apply buffer strips and avoid sensitive areas.*

To the strategies specified for each of the types of development, namely residential, commercial, industrial, institutional, circulation/transportation, and community facilities and services, add:

*To new development, apply best management practice in order to reduce runoff pollution of streams and of the Delaware Estuary.*

Add two new paragraphs as follows:

*In order to protect the streams and the Delaware Estuary from pollution, a program to minimize runoff pollution from new development is required within the zone of influence. This includes buffer strip set-backs on streams designated on the map, Figure 2A, and the application of best management practices to new development. This program is the outgrowth of a study indicating that Aston Township is within the "primary zone of influence" of the Delaware Estuary and therefore requires priority attention to runoff pollution for protection of the Delaware Estuary as well as the local environment.*

*Features of this plan, including application of best management practices and streamside buffer set-backs, will satisfy proposed requirements of a plan to protect the Delaware Estuary from runoff pollution from new development as implemented by regulations of the Commonwealth.*

In the recommendations for implementation, the following should be added:

- *In order to protect the Delaware Estuary and local streams, establishment of streamside buffers and best management practices on new development will be required within the zone of influence.*
- *Coordination with state and county authorities will be required regarding planning and best management practices for new development, such as highways, in the interest of curbing nonpoint source runoff pollution.*

#### **5.4 Chester Heights Borough (Recommended Changes to Ordinances and Plans)**

##### **5.4.1 Chester Heights Subdivision and Land Development Ordinance**

To the stated purposes add:

*and to provide by means of streamside buffer strips and best management practices for the reduction of pollution in streams caused by new development and redevelopment within the zone of influence.*

To the definitions add:



*"Best Management Practice." Either a structural or nonstructural requirement imposed in the interest of controlling runoff pollution.*

*"Runoff Pollution." That pollution which is carried by runoff from any facility or development.*

*"Special Best Management Practices." Practices including more effective provisions than those ordinarily applied for the control of runoff pollution.*

*"Standard Best Management Practices." Those practices ordinarily applied for the control of runoff pollution.*

*"Buffer Strip." A designated reserved area adjacent to streams within which building is restricted and adjacent to which special controls over runoff pollution are imposed in the interest of reducing pollution of the stream or of the Delaware Estuary.*

*"Zone of Influence." Portion of the Delaware Estuary drainage defined as requiring priority attention to preventing increases in runoff pollution.*

In describing the Conservation Plan, runoff pollution control measures should be listed among the structures to be shown.

#### **5.4.2 Chester Heights Zoning Ordinance**

To the purposes should be added:

*...and by minimizing runoff pollution of streams and of the Delaware Estuary.*

To the definitions should be added:

*"Best Management Practice." Required practice, either structural or nonstructural, imposed in the interest of controlling runoff pollution.*

*"Runoff Pollution." That pollution which is carried by runoff from any facility or development.*

*"Streamside Buffer Strip." A designated reserved area adjacent to streams within which building is restricted and adjacent to which special controls over runoff pollution are imposed in the interest of reducing pollution of the stream.*

In the section regarding Federal, State, County or Municipally owned property, there should be added a provision making municipal property subject *"to the provisions related to runoff pollution."*

To the provisions of Section 1405 restricting location of facilities in the floodway, there should be added the following:





*Detention basins provided as best management practices in the interest of runoff pollution control shall not be located in the floodway and shall not be located in the floodplain unless an engineering analysis has determined that the operation of the basin will not be impaired during floods.*

A new article should be added regarding buffer strips, as follows:

#### **Restrictions on Location In Or Adjacent To Streamside Buffer Strips**

*For the protection of the Delaware Estuary both as regards water quality and habitat, buffer strips of 50 feet width measured from the low flow channel are established along streams as shown on Figure 1.*

*The buffer strip is essentially a site plan set-back within which new construction will not be permitted except where allowed by variances for water-based activities and for essential construction such as bridges. The 20 feet adjacent to the stream may be retained in natural vegetation, unfertilized, or it may be replaced by a graded grass filter strip which the land holder is recommended not to fertilize.*

*Where small building lots have been finally approved, prior to 1 July 1992, the land reserved for a buffer shall not exceed 40 percent of the depth of the lot [e.g., for an 80 foot deep lot, the buffer strip would be only 32 feet in width].*

*Most forms of new development are not allowed within streamside buffer strips established by the Subdivision and Land Development Ordinance. In addition, location within a half mile of these buffer strips of forms of development most apt to cause pollution (Class I, as defined in the Subdivision and Land Development Ordinance) is limited as specified by the ordinance.*

#### **5.4.3 Chester Heights Comprehensive Plan**

To the given community objectives there should be added the following:

*Minimize runoff pollution and consequent harm to streams and to the Delaware Estuary by siting new development away from designated streamside buffer strips and other environmentally sensitive areas and by applying best management practices to new development for control of runoff pollution.*

*Features of the plan, including application of best management practices and streamside buffers, will satisfy proposed requirements of a plan to protect the Delaware Estuary from runoff pollution from new development, insofar as municipal responsibility is concerned.*

*Coordination with county and state authorities will be required regarding planning and best management practices for new development, such as highways, in the interest of curbing runoff pollution in the streams.*



In the section Land Use Plan, under headings of residential and business, apartments and planned residential developments, and light industry a new item should be added as follows:

*Apply best management practices to new development in order to reduce runoff pollution of streams and in the Delaware Estuary.*

#### **5.4.4 Chester Heights Runoff Control Ordinance**

Add a new ordinance as follows:

*The best management practices required to protect the Delaware Estuary and local streams are designed for the removal of the greater portion of particulate pollution from stormwater runoff within the zone of influence. These BMPs are applicable to all new developments or redevelopments which will add 15,000 square feet or more of impervious surface. The most important particulates removed include heavy metals, hydrocarbons, sediment, bacteria, and some forms of phosphorous. These practices require detention and slow release of runoff from the numerous small storms which carry most of the particulate pollution, while control of the larger storms may be subject to provisions of stormwater management plans. If control of the larger storms is not to be provided for concurrently, the control of smaller storms shall be carried out nonetheless.*

*There are two levels of BMPs, standard and special. The selection of applicable BMPs is covered in the following section. These BMPs are technology-based, that is, although their objective is improved water quality, the BMPs are designed in terms of required structures and/or practices not mathematically related to water quality criteria. The required BMPs are described first in terms of dry detention basins (extended detention) followed by enumeration of alternative measures of accomplishing an equivalent effect.*

*The basic method is described in ASCE/WPCF manual of practices "The Design and Construction of Urban Stormwater Management Systems," ASCE Publication No. 77, 1993. It consists of prolonged detention of the relatively frequent smaller storms allowing particulates to settle, with provisions for necessary flood control retention of the runoff from infrequent larger storms, if applicable. The selected small storm chosen for prolonged detention is called the "water quality design storm." For standard BMPs, the "water quality design storm" is a one year frequency 24-hour storm or, alternatively, a storm of 1 1/4 inches occurring in two hours. The water so impounded is to be 90 percent released in a period of 18 hours for residential development and 36 hours for non-residential development.*

*For special BMPs, the water quality design storm is a one year frequency 24-hour storm and the 90 percent release time is 48 hours.*

*Alternatives to dry detention basins include wet basins and infiltration basins which, if they meet requirements specified above, provide a higher degree of efficiency than dry detention basins and can be accepted as meeting provisions of special BMPs (provided the permanent pool of the wet basin is at least equal in volume to twice the water quality storm runoff).*



*Various BMPs other than detention can meet the designated requirements, subject to an engineering examination in order to verify the equivalence. Various at-site provisions such as swales, grass filter strips, dry wells, roof-top storage or source controls of pollutants alone or in combination with some provision of retention can provide effective results.*

*Selection of BMPs - It is clear that BMPs for runoff control should not be applied across-the-board, but that degree of control required depends on both the inherent harmfulness of the facility in question and any special sensitivity of the area affected by the runoff. A harmfulness index of stormwater runoff, classified by origin, may be summarized as follows.*

*New developments of Class 1 harmfulness are those inherently likely to contribute to runoff pollution. Proposed developments in business zones shall be considered Class 1 unless it is shown that impervious coverage will be below 50 percent, that the type of coverage and low vehicle use (such as warehouses), will assure relatively uncontaminated runoff, and that the development will not contribute any inadequately treated wastewater or effluent. Housing developments with density of less than one third of an acre per housing unit, gas stations, state and county highways, and shopping centers are also Class 1. New commercial, industrial or housing developments excluded from Class 1 by the provisions of the preceding two sentences shall be Class 2. In cluster housing, the classification of the "cluster" as Class 1 may be compensated for by separate classification of the surrounding portions of the project.*

*Class 1 new developments, where allowed, require special BMPs throughout the Primary zone of influence. Class 2 new developments in general require only standard BMPs unless located within a half mile of a streamside buffer strip established by this program, in which case special BMPs are required. For state or Federal designated sensitive areas, restrictions either in or outside the area will be as required by state or Federal law.*

*Class 1 new developments shall not be built within a half mile of a streamside buffer established by this program unless allowed by variance and after submission of an engineering analysis including provisions for minimizing any pollution from either runoff or waste water. Such provisions shall be made a condition of the permit.*

*Usually the requirements for BMPs are applied separately to each development. However a drainage basin planning approach can often provide an overall plan including at-site and regional facilities in a combination which reduces costs to individual developers while still achieving the desired results. In regional plans, particular care must be taken for provisions of facilities' maintenance.*

*General - Temporary structures are usually required during the construction period for soil erosion and sediment controls and may be revised thereafter. Permanent structures are required for stormwater management and BMPs.*

*Under outlet control structures, two provisions should be included, as follows:*

*If for small facilities, the indicated size of the lower outlet to obtain the required detention time is less than two inches in diameter, the outlet should be sized at two inches and the time of detention reduced accordingly.*



*The design approach to meet both the water quality and the flood control requirements is to provide a lower small outlet protected by trash racks to handle releases for the smaller storms (less than the water quality design storm specified water runoff control measures, Section I above). At higher elevations, larger flood control outlets and emergency spillway are provided.*

## **5.5 Middletown Township (Recommended Changes to Ordinances and Plans)**

### **5.5.1 Middletown Township Subdivision and Land Development Ordinance**

To the stated purposes, add:

*To provide by means of streamside buffer strips and best management practices in handling stormwater for the reduction of pollution in streams from new development within the zone of influence as defined by the Commonwealth.*

The objective of permitting unimpeded flow of natural streams should be modified as follows:

*Permit unimpeded flow of natural streams except where required for control of floods and runoff pollution.*

An additional purpose should be added, as follows:

*Provide for reduction of pollution from storm runoff by best management practices.*

An additional requirement should be included as follows:

*Clarify degree of environmental harmfulness of the facility proposed. Check whether affected by streamside buffer strips (Item 521). Determine whether "standard" or "special" degree of best management practices are required (see Ordinance on Soil Erosion and Sediment Control, Stormwater Management and Best Management Practices).*

A new section on buffer strips should be added:

*For the protection of the Delaware Estuary and of local streams both as regards water quality and habitat, buffer strips of 50 feet width measured from the low flow channel are established along streams as designated.*

*The buffer strip is essentially a site plan set-back within which new construction will not be allowed except for where allowed by variances for water-based activities and for essential construction such as bridges. The 20 feet adjacent to the stream may be retained in natural vegetation, unfertilized, but it may be replaced by a graded grass filter strip upon which the land holder is encouraged to apply no fertilizer.*

*Where building lots have been given preliminary approval, prior to 1 July 1992, the land reserved for a buffer shall not exceed 40 percent of the depth of the lot (e.g., for an 80-foot deep lot, the buffer strip would be only 32 feet in width).*





*Special requirements for drainage of storm runoff through buffer strips are covered under the selection of BMPs (Ordinance 471, revised).*

### **5.5.2 Middletown Township Zoning Ordinance**

The only change necessary is to add the following:

*Most forms of new development are not allowed within streamside buffer strips established by the Subdivision and Land Development Ordinance. In addition, locations within a half mile of these buffer strips of forms of development most apt to cause pollution (Class I) is limited as specified by that ordinance.*

### **5.5.3 Middletown Township Soil Erosion and Sediment Control, Stormwater Management and Best Management Practices**

The purposes of the act, specified in Section 211, should be modified by adding "including abatement of runoff pollution" and the following:

*...and to provide a measure of control over runoff pollution for the protection of the Delaware Estuary and local streams.*

*This Ordinance covers three interrelated programs applicable to new development. Soil erosion and sedimentation control applies primarily to activities during the construction period designed to reduce sedimentation and erosion at that time and thereafter. Stormwater management is a program with permanent provisions which reduces the flooding caused by the development process. Best management practices (BMPs), as used in this regulation, refers to measures taken to reduce pollution from runoff. They are usually provided by detention basins also used for stormwater management but may be provided by other means.*

The provision for continued maintenance of stormwater management facilities in the area of development by landowners associations should have the following added:

*...but in the event of the failure to perform of the association, the owners of the properties covered shall be held responsible, separately, for their respective pro rata shares or other agreed basis.*

The provision for measures to be taken by landowners and other developers should have added the purpose "To provide control of pollution from runoff from new development."

The requirements for runoff or control measures should be changed in several ways, as follows. First, add the following:

*"Rate of Runoff Control." The maximum rate of stormwater runoff from any proposed land disturbance activity shall not exceed the maximum rate of runoff prior to development (i.e.,*



*zero (0) increase runoff) except as allowed elsewhere in this Ordinance. This standard shall be maintained for all storm frequencies.*

Secondly, in the discussion of detention basins include the purpose of "...controlling the rate of particulate pollution" as well as the rate of runoff. Also, note that runoff control other than detention basins may include "...grass filter strips or infiltration basins" as well as those now listed. Thirdly, add the following:

*No detention basins will be built in the floodway except for those on-stream. Detention basins elsewhere in the floodplain (the flood fringe) will not be built without a detailed engineering analysis to verify their adequacy of functioning during floods.*

Add the following section:

#### *Best Management Practices (BMPs)*

*a. General - The best management practices required to protect the Delaware Estuary and local streams are designed for the removal of the greater portion of particulate pollution from stormwater runoff within the zone of influence. These BMPs are applicable to all new developments or redevelopments which will add 15,000 square feet or more of impervious surface. The most important particulates removed include heavy metals, hydrocarbons, sediment, bacteria, and some forms of phosphorous. These practices require detention and slow release of runoff from the numerous small storms which carry most of the particulate pollution while control of the larger storms is subject to provisions of the preceding section. Both sets of requirements must be observed.*

*There are two levels of BMPs, standard and special. The selection of applicable BMPs is covered in the following section. These BMPs are technology-based, that is, although their objective is improved water quality, the BMPs are designed in terms of required structures and/or practices not mathematically related to water quality criteria. The required BMPs are described first in terms of dry detention basins (extended detention) followed by enumeration of alternative measures of accomplishing an equivalent effect.*

*The basic method is described in ASCE/WPCF manual of practice "The Design and Construction of Urban Stormwater Management Systems," ASCE Publication No. 77, 1993. It consists of prolonged detention of the relatively frequent smaller storms, allowing particulates to settle, with provisions for necessary flood control retention of the runoff from infrequent, larger storms. If the control of large storms is not to be implemented concurrently, the control of small storms will be required nonetheless. The selected small storm chosen for prolonged detention is called the "water quality design storm". For standard BMPs, the "water quality design storm" is a one year frequency 24-hour storm or, alternatively, a storm of 1 1/4 inches occurring in two hours. The water so impounded is to be 90 percent released in a period of 18 hours for residential development and 36 hours for non-residential development. For special BMPs, the water quality design storm is a one year frequency 24-hour storm and the 90 percent release time is 48 hours.*



*Alternatives to dry detention basins include wet basins and infiltration basins which, if they meet requirements specified above, provide a higher degree of efficiency than dry detention basins and can be accepted as meeting provisions of special BMPs (provided the permanent pool of the wet basin is at least equal in volume to twice the water quality storm runoff).*

*Various BMPs other than detention can meet the designated requirements subject to an engineering examination in order to verify the equivalence. Various at-site provisions such as swales, grass filter strips, dry wells, roof-top storage or source controls of pollutants alone or in combination with some provision of retention can provide effective results.*

*Selection of BMPs - It is clear that BMPs for runoff control should not be applied across-the-board, but that the degree of control required depends on both the inherent harmfulness of the facility in question and any special sensitivity of the area affected by the runoff. A harmfulness index of stormwater runoff, classified by origin, may be summarized as follows.*

*New developments of Class 1 harmfulness are those inherently likely to contribute to runoff pollution. Proposed developments in zones classified as B, B-1, B-2, PBC, Office Campus, Office, and M shall be considered Class 1 unless it is shown that impervious coverage will be below 50 percent, that the type of coverage and low vehicle use (such as warehouses) will assure relatively uncontaminated runoff, and that the development will not contribute any inadequately treated wastewater or effluent. Housing developments with density of less than one third of an acre per housing unit, gas stations, state and county highways, and shopping centers are Class 1.*

*New commercial, industrial or housing developments excluded from Class 1 by the provisions of the preceding two sentences shall be Class 2. In cluster housing, the classification of the "cluster" as Class 1 may be compensated for by separate classification of the surrounding portions of the project.*

*Class 1 new developments, where allowed, require special BMPs throughout the Primary zone of influence. Class 2 new developments in general require only standard BMPs unless located within a half mile of a streamside buffer strip established by this program, in which case special BMPs are required. For state or Federal designated sensitive areas, restrictions either in or outside the area will be as required by state or Federal law.*

*Class 1 new developments shall not be built within a half mile of a streamside buffer established by this program unless allowed by variance and after submission of an engineering analysis including provisions for minimizing any pollution from either runoff or waste water. Such provisions shall be made a condition of the permit.*

*Usually the requirements for BMPs are applied separately to each development. However, a drainage basin planning approach can often provide an overall plan including at-site and regional facilities in a combination which reduces costs to individual developers while still achieving the desired results. In regional plans, particular care must be taken for provisions of facilities' maintenance.*



*General - Temporary structures are usually required during the construction period for soil erosion and sediment controls and may be revised thereafter. Permanent structures are required for stormwater management and BMPs.*

Under outlet control structures, two new provisions should be included, as follows:

*If for small facilities, the indicated size of the lower outlet to obtain the required detention time is less than two inches in diameter, the outlet should be sized at two inches and the time of detention reduced accordingly.*

*The design approach to meet both the water quality and the flood control requirements is to provide a lower small outlet protected by trash racks to handle releases for the smaller storms (less than the water quality design storm specified water runoff control measures, Section I above). At higher elevations, larger flood control outlets and emergency spillway are provided.*

The provisions regarding subsurface disposal of stormwater should be amended by adding the following:

*...and after it has been determined that infiltration of the runoff will not adversely affect desired water quality of the ground water."*

#### **5.5.4 Middletown Township Comprehensive Plan**

The environmental resources objectives should have the following added:

*Site new development so as to minimize nonpoint source pollution of streams and of the Delaware Estuary.*

The general strategies should have added:

*In the siting of new development, apply buffer strips along streams and avoid sensitive areas.*

As regards the various types of development named (residential, commercial, industrial, institutional, circulation/transportation, community facilities and utilities), the strategy outlined should include the following:

*Apply best management practices to new development in order to reduce nonpoint source pollution of streams and of the Delaware Estuary.*

Under the heading of stream protection a new section should be added as follows:

*In order to protect the streams and the Delaware Estuary from pollution, a program to minimize runoff pollution from new development is required. This includes buffer strip set-backs on streams designated on the map and the application of best management practices*





*to new development. This program is the outgrowth of a study indicating that Middletown Township is within the "primary zone of influence" of the Delaware Estuary and therefore requires priority attention to runoff pollution for protection of the Delaware Estuary as well as of the local environment.*

Three more items should be added, as follows:

*In order to protect the Delaware Estuary and the local streams, streamside buffers and application of best management practices on new development will be required.*

*Coordination with county and state authorities will be required regarding planning and best management practices for new development, such as highways, in the interest of curbing nonpoint source pollution.*

*Features of this plan including application of best management practices and streamside buffer setbacks will satisfy proposed requirements of a plan to protect the Delaware Estuary from runoff pollution from new development and will comply with state regulations prepared to achieve this objective.*

## **6.0 INTERIM VOLUNTARY ACTION**

It is recognized that there might be some time, perhaps several years, before the Governor and the legislature complete action on this program. In this case, it would be desirable to provide guidance through which municipalities would be encouraged to take appropriate action on a voluntary basis to protect the Estuary and their own local streams. Moreover, it is conceivable that the municipalities might be sufficiently concerned and wish to implement the program voluntarily without a state mandate. A separate guidebook has been prepared to meet this interim voluntary need: Pennsylvania Demonstration Project: Guidance for Voluntary Local Government Implementation of Nonpoint Source Pollution Control: Protecting Local Streams and the Delaware Estuary, June 1994. This guidance (1) describes the importance and benefits of nonpoint source pollution control to local communities, (2) describes what is needed and how communities can implement a program within existing authorities, (3) identifies potential funding sources in Pennsylvania that would be used to fund the planning efforts and future program needs, and (4) provides some examples of ordinance language ("model ordinances") that could be used to integrate nonpoint source controls into typical ordinances. This guidance is consistent with the specific provisions of the BMP regulations for the Delaware Estuary.



Guidance could also be used later to complement existing direction under the Stormwater Management Act rather than as regulations under a new act, if the state decides to implement a long-range program in this manner. Language in the regulations indicating that certain action would be "required" would be changed to "encouraged." Certain other changes of the language would be necessary to recognize the lack of new legislative authority, as shown in the suggested guidance (Appendix 5). This guidance, referred to as Delaware Estuary Runoff Guidance, could be issued under authority of the Stormwater Management Act. After formal approval of the program and enactment of the Delaware Estuary Act, the "Runoff Guidance" could be superseded by the mandatory regulations proposed under that act. The proposed regulations (Appendix 4) are similar to this guidance except for their mandatory character, the establishment of the new Agency, the requirement in the regulations that the new Agency conduct a survey of the zone of influence, and the provision for appropriations.

Implementation of a complete program requires a delineation of the zone of influence. The lack of a survey of the zone of influence would considerably handicap implementing action because in many cases it could not be definitively stated which parts of a township were affected. Accordingly, for townships some distance from the Estuary, it would be difficult to pass an implementing ordinance because the spatial limits of its application would not have been determined. For a voluntary program, efforts could be initiated immediately for obvious waterfront communities and for several tier communities (those adjoining waterfront communities). Ordinances could be implemented community-wide since it is very likely that all of these communities would be within the zone of influence. Eventually, it will be necessary for the Commonwealth to delineate the zone of influence.

## **7.0 SUMMARY AND CONCLUSIONS**

The most feasible way of implementing the DELEP for Land Use Management and NPS Control would be by means of a special Delaware Estuary Protection Act and accompanying regulations which would be applicable only within the zone of influence of the Delaware Estuary. The recommended program would



apply BMPs to new development and redevelopment for the purpose of controlling the increase of particulate pollution which would otherwise impact the Estuary and its tributary streams. The program would be very beneficial to wildlife because of the control of water pollution and limitation on activities in buffer strips, but it would not include provisions required solely for wildlife protection which are being planned by another DELEP committee. Carrying out this program would avoid future increases in polluted runoff impacts which will otherwise occur due to new development near the Estuary. Although the program was initiated for the protection of the Delaware Estuary, it could have significant benefits for the local streams of the municipalities involved. It would cost much less than programs designed to reduce runoff pollution from existing facilities.

Programs of land use planning and of stormwater management in Pennsylvania would be considerably affected by this change. Although the basic laws governing those programs would remain unchanged, provisions of the new Delaware Estuary Protection Act would prevail in the areas and for the types of construction specified.

Local ordinances would be amended to comply with the new act as indicated for the three municipalities examined in detail for the Demonstration Project. In the case of Stormwater Management, the required revision of existing stormwater management plans and the preparation of new plans every five years would provide the occasion for including in those plans requirements of the Delaware Estuary Protection Act (although the provisions of the new act would be applicable before such revisions).

The BMPs to be enforced are similar in most respects to those which have been used in parts of New Jersey for about 12 years and also to those more recently established throughout the state of Delaware. Although not previously required in Pennsylvania, they have been accepted in concept by the engineering profession nationally.

Implementation of the new program would require initial funding to cover the survey of the zone of influence and to reimburse municipalities for the administrative costs of revision of municipal ordinances.



Also, the staffing of a new state office would be required. Financial impacts on municipalities would be minimal since permit fees would be used to reimburse them for expenses necessary for the program.

This program is part of a tri-state initiative by the Governors of Delaware, New Jersey and Pennsylvania, and is subject to formal adoption by the governors and legislatures of the three states. It would provide an initial action phase in a more comprehensive plan now under development, which will ultimately include recommendations for wildlife protection.

Local and state officials consulted are all favorably disposed towards the objective of the plan proposed which is developed so as to cause minimum cost to municipalities, little real impact on developers, and minimum disruption of on-going programs. However, the matter of whether the Governor and the legislature will decide to adopt such a program remains to be decided.

In the event of a long delay in implementing this program, voluntary action by municipalities are encouraged. However, this course of action is unlikely to satisfy the need for a tri-state agreement and would not be as effective as implementation of the permanent program.







## REFERENCES

- Metropolitan Council of Governments. "Controlling Urban Runoff." July 1987.
- Niewswand, G.H., Hordon, R.M., Shelton, T.B., Chavooshian, B.B., and Blarr, S.L. "Buffer Strips to Protect Water Supply Reservoirs: A Model and Recommendations." Water Resources Bulletin. 26, 6, December 1990. pp. 959-966.
- Pennsylvania Department of Community Affairs. Pennsylvania Municipalities Planning Code. January 1969.
- Stormwater Management Act. October 4, 1978. PL684, No. 167, 32 PS 680 et. seq.
- The Greeley-Polhemus Group, Inc. Briefing Paper No. 1: Delaware Estuary Environmental Problems and Existing Land Use Management Programs. September 1991.
- The Greeley-Polhemus Group, Inc. Briefing Paper No. 2: Discussion of Land Use Control Options to Protect Delaware Estuary Water Quality. November 1991.
- The Greeley-Polhemus Group, Inc. Briefing Paper No. 3: Options for Implementing Land Use Management and NPS control for the Delaware Estuary. March 1992.
- The Greeley-Polhemus Group, Inc. Delaware Estuary Program Land Use Management Inventory and Assessment Report. December 1990.
- The Greeley-Polhemus Group, Inc. Pennsylvania Demonstration Project: Guidance for Voluntary Local Government Implementation of Nonpoint Source Pollution Control Protecting Local Streams and the Delaware Estuary. June 1994.
- U.S. Environmental Protection Agency. "Proposed Guidance Specifying Management Issues for Sources of NPS Pollution in Coastal Areas." U.S. EPA Federal Register. June 14, 1991. (56 FR 27, 618).
- Whipple, W., Jr. "Best Management Practices for Stormwater and Infiltration Control." Water Resources Bulletin. December 1991. pp. 895-902.
- Whipple, W., Jr. "Buffer Zones Around Water Supply Reservoirs." Journal of Water Resources Planning and Management ASCE. 119, 4. July/August 1993.





## **APPENDIX 1:**

### **PROPOSED CHANGES - STORMWATER MANAGEMENT ACT**

The Stormwater Management Act of Pennsylvania, enacted in 1978, as amended, currently provides for the management of accelerated runoff of stormwater resulting from development. The Act, however, was designed to address the quantity of water and does not address the quality of runoff.

Modifications are proposed in this Appendix that would include control of stormwater quality as well. Underlined text describes the added requirements that would implement the expanded water quality controls to protect the Delaware Estuary.







The General Assembly of the Commonwealth of Pennsylvania hereby enacts as follows:

**Section 1. Short title.**

This act shall be known and may be cited as the "Storm Water Management Act."

**Section 2. Statement of legislative findings.**

The General Assembly finds that:

(1) Inadequate management of accelerated runoff of storm water resulting from development throughout a watershed increases flood flows and velocities, contributes to erosion and sedimentation, overtaxes the carrying capacity of streams and storm sewers, greatly increases the

cost of public facilities to carry and control storm water, undermines flood plain management and flood control efforts in downstream communities, reduces ground-water recharge, and threatens public health and safety.

(2) A comprehensive program of stormwater management, including reasonable regulation of development and activities causing accelerated runoff (and water quality degradation) is fundamental to the public health, safety and welfare and the protection of the people of the Commonwealth, their resources and the environment.

**Section 3. Purpose and policy.**

The policy and purpose of this act is to:

(1) Encourage planning and management of storm water runoff in each watershed which is consistent with sound water and land use practices.

(2) Authorize a comprehensive program of storm water management designated to preserve and restore the flood carrying capacity of Commonwealth streams; to preserve to the maximum extent practicable natural storm water runoff regimes and natural course, current and cross-section of water of the Commonwealth; and to protect and conserve ground waters and ground-water recharge area, and existing water quality of the receiving water bodies.

(3) Encourage local administration and management of storm water consistent with the Commonwealth's duty as trustee of natural resources and the people's constitutional right to the preservation of natural, economic, scenic, aesthetic, recreational and historic values of the environment.

(4) Require county and local authorities to implement measures to prevent water quality degradation associated with storm runoff from land development activities, as necessary to protect the Delaware Estuary.



#### Section 4. Definitions.

The following words and phrases when used in this act shall have, unless the context clearly indicates otherwise, the meanings given to them in this section:

"BMP (Best Management Practices)." Practices, procedures or structures required for the purpose of reducing pollution from runoff.

"Department." The Department of Environmental Resources of the Commonwealth of Pennsylvania.

"Municipality." A city, borough, town or township, or any county or other governmental unit when acting as an agent thereof, or any combination thereof acting jointly.

"Pennsylvania Municipalities Planning Code." The act of July 31, 1968 (P.L.805, No.247), as amended.

"Person." An individual, partnership, public or private association or corporation, firm, trust, estate, municipality, governmental unit, public utility or any other legal entity whatsoever which is recognized by law as the subject of rights and duties. Whenever used in any section prescribing or imposing a penalty, the term "person" shall include the members of a partnership, the officers, members, servants and agents of an association, officers, agents and servants of a corporation, and the officers of a municipality or county, but shall exclude any department, board, bureau or agency of the Commonwealth.

"Primary Zone of Influence of the Delaware Estuary." Those watersheds and portions of watersheds considered most likely to impact the Estuary through runoff pollution.

"Public utility service." The rendering of the following services for the public:

- (1) gas, electricity or steam production, generation, transmission or distribution;
- (2) water diversion, pumping, impoundment, or distribution;
- (3) railroad transportation of passengers or property;
- (4) operation of a canal, turnpike, tunnel, bridge, wharf or similar structure;
- (5) transportation of natural or artificial gas, crude oil, gasoline or petroleum products, materials for refrigeration or other fluid substances by pipeline or conduit;
- (6) telephone or telegraph communications; and
- (7) sewage collection, treatment or disposal.

"Storm water." Drainage runoff from the surface of the land resulting from precipitation or snow or ice melt.

"Stormwater Management Regulations, Delaware Estuary." Regulations issued in accordance with Section 14(a)(12).

"Watershed." The entire region or area drained by a river or other body of water, whether natural or artificial.

"Watershed storm water plan." A plan for storm water management adopted by a county in accordance with section 5.



**Section 5. Watershed storm water plans and contents.**

(a) Within two years following the promulgation of guidelines by the department pursuant to section 14, each county shall prepare and adopt a watershed storm water management plan for each watershed located in the county as designated by the department, in consultation with the municipalities located within each watershed, and shall periodically review and revise such plan at least every five years. The department may, for good cause shown, grant an extension of time to any county for the preparation and adoption of a watershed storm water management plan.

(b) Each watershed storm water plan shall include, but is not limited to:

(1) a survey of existing runoff characteristics in small as well as large storms, including the impact of soils, slopes, vegetation and existing development;

(2) a survey of existing significant obstructions and their capacities;

(3) an assessment of projected and alternative land development patterns in the watershed, and the potential impact of runoff quantity, velocity and quality;

(4) an analysis of present and projected development in flood hazard areas, and its sensitivity to damages from future flooding or increased runoff;

(5) a survey of existing drainage problems and proposed solutions;

(6) a review of existing and proposed storm water collection systems and their impacts;

(7) an assessment of alternative runoff control techniques and their efficiency in the particular watershed;

(8) an identification of existing and proposed State, Federal and local flood control projects located in the watershed and their design capacities;

(9) a designation of those areas to be served by storm water collection and control facilities within a ten-year period, an estimate of the design capacity and costs of such facilities, a schedule and proposed methods of financing the development, construction and operation of such facilities, and an identification of the existing or proposed institutional arrangements to implement and operate the facilities;

(10) an identification of flood plains within the watershed;

(11) criteria and standards for the control of storm water runoff from existing and new development which are necessary to minimize dangers to property and life and carry out the purposes of this act;

(12) priorities for implementation of action within each plan; and

(13) provisions for periodically reviewing, revising and updating the plan.

(c) Each watershed storm water plan shall:

(1) contain such provisions as are reasonably necessary to manage storm water such that development or activities in each municipality within the watershed do not adversely affect health, safety and property in other municipalities within the watershed and in basins to which the watershed is tributary; and

(2) consider and be consistent with other existing municipal, county, regional and State environmental and land use plans.





(d) The counties having watersheds or portions thereof designated as within the Primary Zone of Influence by the Stormwater management Regulations (Delaware Estuary), shall undertake watershed stormwater planning. If sufficient funds for a complete study are not available, this shall be done by an initial phase of requiring BMPs on all new development and on designated types of redevelopment, as specified in the regulations. The initial phase shall be implemented promptly in each designated watershed, starting in each case within a year after adoption of an interstate agreement requiring such a program. Provisions of Section 17 shall not be applicable to this initial phase of stormwater management. If a complete study including provisions of Section 5(a)(b) and (c) above can be funded, it shall include provisions in compliance with Stormwater Management Regulations (Delaware Estuary).

**Section 6. Municipal and public participation in watershed planning.**

(a) The county shall establish, in conjunction with each watershed storm water planning program, a watershed plan advisory committee composed of at least one representative from each municipality within the watershed, the county soil and water conservation district and such other agencies or groups as are necessary and proper to carry out the purposes of the committee.

(b) Each committee shall be responsible for advising the county throughout the planning process, evaluating policy and project alternatives, coordinating the watershed storm water plans with other municipal plans and programs, and reviewing the plan prior to adoption.

(c) Prior to adoption, each plan shall be reviewed by the official planning agency and governing body of each municipality, the county planning commission and regional planning agencies for consistency with other plans and programs affecting the watershed. All such reviews shall be submitted to the department with the proposed plan.

**Section 7. Joint plans and coordination of planning.**

Where a watershed includes land in more than one county, the department may require the affected counties to prepare, adopt and submit a joint plan for the entire watershed.

**Section 8. Adoption and amendment.**

(a) Prior to adoption or amendment of a watershed storm water plan, the county shall hold a public hearing pursuant to public notice of not less than two weeks. The notice shall contain a brief summary of the principal provisions of the plan, and a reference to the places within each affected

municipality where copies may be examined or purchased at cost.

(b) Adoption or amendment of the plan shall be by resolution carried by an affirmative vote of at least a majority of the members of the county governing body. The resolution shall refer expressly to the maps, charts, textual matter and other materials intended to form the whole or part of the official plan, or amendment thereto, and the action shall be recorded on the adopted plan, part or amendment.



Section 9. Review and approval by the department.

(a) The department shall, in consultation with the Department of Community Affairs, review all watershed storm water plans and revisions or amendments thereto. It shall approve the plan if it determines:

(1) that the plan is consistent with municipal flood plain management plans, State programs which regulate dams, encroachments, and water obstructions, and State and Federal flood control programs; and

(2) that the plan is compatible with other watershed storm water plans for the basin in which the watershed is located, and is consistent with the policies and purposes of this act.

(3) that any plans prepared and submitted in compliance with the provisions of Section 5(d) is in compliance with the law and with the Stormwater Management Regulations (Delaware Estuary).

(b) Should the department neither approve or disapprove a watershed plan or amendment or revision thereto within 90 days of its submission to the department, the plan or amendment or revision shall be deemed to be approved.

(c) Any person aggrieved by a final decision of the department approving or disapproving a watershed plan or amendment thereto, may appeal the decision to the Environmental Hearing Board in accordance with the provisions of section 1921-A of the act of April 9, 1929 (P.L.177, No.175), known as "The Administrative Code of 1929," and the act of June 4, 1945 (P.L.1388, No.442), known as the "Administrative Agency Law."

Section 10. Failure to submit plan; mandamus.

The department may institute an action in mandamus in the Commonwealth Court to compel counties to adopt and submit plans in accordance with this act.

Section 11. Effect of watershed storm water plans.

(a) After adoption and approval of a watershed storm water plan in accordance with this act, the location, design and construction within the watershed of storm water management systems, obstructions, flood control projects, subdivisions and major land developments, highways and transportation facilities, facilities for the provision of public utility services and facilities owned or financed in whole or in part by funds from the Commonwealth shall be conducted in a manner consistent with the watershed storm water plan.

(b) Within six months following adoption and approval of the watershed storm water plan, each municipality shall adopt or amend, and shall implement such ordinances and regulations, including zoning, subdivision and development, building code, and erosion and sedimentation ordinances, as are necessary to regulate development within

the municipality in a manner consistent with the applicable watershed storm water plan and the provisions of this act.



**Section 12. Failure of municipalities to adopt implementing ordinances.**

(a) If the department finds that a municipality has failed to adopt or amend, and implement such ordinances and regulations as required by section 11, the department shall provide written notice of violation to the municipality.

(b) Within 60 days of receipt of the notice of violation, the municipality shall report to the department the action which it is taking to comply with the requirement or regulation.

(c) If within 180 days of receipt of the notice of violation, the municipality has failed to comply with such requirement or regulation, as determined by the department, the department shall notify the State Treasurer to withhold payment of all funds payable to the municipality from the General Fund. Provided, that prior to any withholding of funds, the department shall give both notice to the municipality of its intention to notify the State Treasurer to withhold payment of funds and the right to appeal the decision of the department within the 180-day period following notification. The hearing shall be conducted before the Environmental Hearing Board in accordance with the provisions of the act of April 9, 1929 (P.L.177, No.175), known as "The Administrative Code of 1929," and Chapters 5 and 7 of Title 2 (Administrative Law and Procedure), of the Pennsylvania Consolidated Statutes. If an appeal is filed within the 180-day period, funds shall not be withheld from the municipality until the appeal is decided.

(d) Any person, other than a municipality, aggrieved by an action of the department shall have the right within 30 days of receipt of notice of such action to appeal such action to the Environmental Hearing Board, pursuant to section 1921-A, act of April 9, 1929 (P.L.177, No.175), known as "The Administrative Code of 1929," and the provisions of Chapters 5 and 7 of Title 2 (Administrative Law and Procedure) of the Pennsylvania Consolidated Statutes.

**Section 13. Duty of persons engaged in the development of land.**

Any landowner and any person engaged in the alteration or development of land which may affect storm water runoff characteristics shall implement such measures consistent with the provisions of the applicable watershed storm water plan as are reasonably necessary to prevent injury to health, safety or other property. Such measures shall include such actions as are required:

- (1) to assure that the maximum rate of storm water runoff is no greater after development than prior to development activities; or
- (2) to manage the quantity, velocity and direction of resulting storm water runoff in a manner which otherwise adequately protects health and property from possible injury.





**Section 14. Powers and duties of the Department of Environmental Resources.**

(a) The Department of Environmental Resources shall have the power and its duty shall be to:

(1) Coordinate the management of storm water in the Commonwealth.

(2) Provide in cooperation with the Department of Community Affairs technical assistance to counties and municipalities in implementing this act.

(3) After notice and public hearing and subject to the requirements of subsection (b) of this section, publish guidelines for storm water management, and model storm water ordinances for use by counties and municipalities.

(4) Review, in cooperation with the Department of Community Affairs, and approve all watershed plans and revisions thereto.

(5) Cooperate with appropriate agencies of the United States or of other states or any interstate agencies with respect to the planning and management of storm water.

(6) Serve as the agency of the Commonwealth for the receipt of moneys from the Federal Government or other public or private agencies or persons and expend such moneys as appropriated by the General Assembly for studies and research with respect to planning and management of storm water.

(7) Conduct studies and research regarding the causes, effects and hazards of storm water and methods for storm water management.

(8) Conduct and supervise educational programs with respect to storm water management.

(9) Require the submission of records and periodic reports by county and municipal agencies as necessary to carry out the purposes of this act.

(10) After notice and hearing and with the approval of the Environmental Quality Board, designate watersheds for the purpose of this act.

(11) In order to implement the provisions of the interstate agreement for the purpose of Delaware Estuary Program, the Department shall designate watersheds having impact on the environment and ecology of the Delaware Estuary for the purpose of determining BMPs and their implementation strategies applicable to new development. The watersheds designated shall be those from which any storm runoff drains into the Delaware Estuary within 40 hours under mean flow conditions, as determined by a survey by the Department.

(12) The Department shall issue regulations applicable only within the watersheds designating as impacting the Delaware Estuary under provisions of Section 14(a)(11) above. Provisions of these regulations shall designate the portions of these watersheds where development is considered most likely to impact the Estuary through stormwater. These portions collectively shall be identified as the Primary Zone of Influence for the Delaware Estuary. Within the Primary Zone of Influence, the regulations shall require best management practices designated to minimize such impacts.





(13) In carrying out provisions of 14a(12), municipalities shall require permits for development and redevelopment under provisions of the regulations. Municipalities may charge a fee to developers representing the average cost to the municipalities of carrying out these provisions.

(14) Do such other acts consistent with this act required to carry out the purposes and policies of this act.

(b) The guidelines for storm water management and model storm water ordinances shall be submitted to the General Assembly for approval or disapproval and shall be considered by the General Assembly under the procedures created for consideration of Reorganization Plan provided in the act of April 7, 1955 (P.L.23, No.8), known as the "Reorganization Act of 1955."

#### Section 15. Civil remedies.

(a) Any activity conducted in violation of the provisions of this act or of any watershed storm water plan, regulations or ordinances adopted hereunder, is hereby declared a public nuisance.

(b) Suits to restrain, prevent or abate violation of this act or of any

watershed storm water plan, regulations or ordinances adopted hereunder, may be instituted in equity or at law by the department, any affected county or municipality, or any aggrieved person. Such proceedings may be prosecuted in the Commonwealth Court, or in the court of common pleas of the county where the activity has taken place, the condition exists, or the public affected, and to that end jurisdiction is hereby conferred in law and equity upon such courts. Except in cases of emergency where, in the opinion of the court, the circumstances of the case require immediate abatement of the unlawful conduct, the court may, in its decree, fix a reasonable time during which the person responsible for the unlawful conduct shall correct or abate the same. The expense of such proceedings shall be recoverable from the violator in such manner as may now or hereafter be provided by law.

(c) Any person injured by conduct which violates the provisions of section 13 may, in addition to any other remedy provided under this act, recover damages caused by such violation from the landowner or other responsible person.

#### Section 16. Preservation of existing rights and remedies.

(a) The collection of any penalty under the provisions of this act shall not be construed as estopping the Commonwealth, any county, municipality or aggrieved person from proceeding in courts of law or equity to abate nuisances under existing law or to restrain, at law or in equity, violation of this act.



(b) It is hereby declared to be the purpose of this act to provide additional and cumulative remedies to abate nuisances.

**Section 17. Grants and reimbursements to counties.**

(a) The Department of Environmental Resources is authorized to administer grants to counties to assist or reimburse them for costs in preparing official storm water management plans required by this act. Grants and reimbursements shall be made from and to the extent of funds appropriated by the General Assembly for such purposes, and shall be made in accordance to rules and regulations adopted by the Environmental Quality Board.

(1) The grant shall be equal to 50% of the allowable costs for preparation of official storm water management plans incurred by any county.

(2) For the purposes of this section, such State grants shall be in addition to grants for similar purposes made to any county by the Federal Government: Provided, That the grants authorized by this section shall be limited such that the total of all State and Federal grants does not exceed 50% of the allowable costs incurred by the county.

(b) Nothing in this section shall be construed to impair or limit application of this act to any municipality or person, or to relieve any municipality or person of duties imposed under this act.

(c) If, in any fiscal year, appropriations are insufficient to cover the costs or grants and reimbursement to all counties eligible for such grants

and reimbursements in that fiscal year, the Department of Environmental Resources shall report such fact to the General Assembly and shall request appropriation of funds necessary to provide the grants authorized in this section. If such a deficiency appropriation is not enacted, any county which has not received the full amount of the grant for which it is eligible under this section shall be as a first priority reimbursed from appropriations made in the next successive fiscal year.

**Section 18. Appropriations.**

(a) The sum of \$500,000, or as much thereof as may be necessary, is hereby appropriated for the fiscal period beginning July 1, 1978, and ending June 30, 1979, to the Department of Environmental Resources for the purposes of administrative and general expenses in implementing the provisions of this act.

(b) In addition to appropriations under provisions of 18a, there is hereby appropriated the sum of \$ \_\_\_\_\_ to defray expenses of the survey required by 14a(11), initial costs to municipalities of passing required ordinances, and other expenses in implementing provisions of this Act.



**Section 19. Repealer and savings clause.**

(a) All acts or parts of acts inconsistent herewith are hereby repealed to the extent of such inconsistency.

(b) The provisions of this act shall not affect any suit or prosecution pending or to be instituted to enforce any right or penalty or punish any offense under the authority of any act of Assembly or part thereof repealed by this act.

**Section 20. Effective date.**

This act shall take effect immediately.

**APPROVED—The 4th day of October, A. D. 1978.**

**MILTON J. SHAPP**



## **APPENDIX 2:**

### **PROPOSED REGULATIONS - STORMWATER MANAGEMENT ACT**

Currently, the Stormwater Management Act of Pennsylvania, as amended, is implemented primarily through state guidance documents (Stormwater Management Guidelines & Model Ordinances, approved by the General Assembly on May 14, 1985). This Appendix provides for control of nonpoint source pollution to the Delaware Estuary through proposed state regulations that would strengthen the degree of compliance that would be achieved through guidance only.







## PROPOSED REGULATIONS STORMWATER MANAGEMENT ACT

### Section 1: Authority.

These regulations are issued pursuant to Section 14(a)(12) of the Stormwater Management Act.

### Section 2: Short Title.

These regulations may be known as the Stormwater Management Regulations (Delaware Estuary).

### Section 3: Coordination With Other Stormwater Management Plans.

Section 5(a)(b) and (c) of the Stormwater Management Act calls for county plans and flood retardation which, however, needs not include any provisions for maintaining water quality of receiving waters, but without any specific provisions for flood retardation. It is advantageous and economical to combine both programs into a combined approach if both are to be done. However, in the event that funding for a more complete stormwater management approach is lacking in any given area, the provisions of these regulations shall be implemented separately as an initial step.

### Section 4: Purpose.

These regulations require county and local authorities to implement measures to prevent water quality degradation associated with storm runoff from land development activities as necessary to protect the Delaware Estuary in accordance with a proposed interstate agreement. They provide a technology-based approach to minimizing runoff pollution from new development by means of best management practices in stormwater management.

### Section 5: Definitions

*"Best Management Practices."* Practices, procedures or structures required for the purpose of reducing pollution from runoff.

*"Delaware Estuary Shore Buffer Strips."* Areas adjacent to the shore of the Delaware Estuary within which certain limitations and controls on new development are required in order to limit pollution from storm runoff (see *Streamside Buffer Strips*).

*"Primary Zone of Influence."* Those watersheds and portions of watersheds considered most likely to impact the Estuary through runoff pollution.

*"Streamside Buffer Strips."* Areas adjacent to waterways within which certain limitations and controls on new developments are required in order to limit pollution from storm runoff (see *Delaware Estuary Shore Buffer Strips*).



*"Water Quality Aspects of Stormwater Management."* The application of stormwater management such as to reduce pollution from runoff in addition to other goals of stormwater management.

Section 6: Runoff Pollution Control (Delaware Estuary Drainage)

Municipal ordinances shall require that all new developments and redevelopments which will involve construction of more than 15,000 square feet of additional impervious surface in designated lands proximate to the Delaware Estuary, as described in Section 7 below, shall apply certain best management practices for reduction of runoff pollution. The municipality may charge an appropriate fee for permitting such construction in an amount approximating the pro rata cost of administration of the regulations. Similar best management practices will be required of construction by municipalities, counties, authorities, or divisions, bureaus, boards or agencies of the Commonwealth. Such best management practices are described in Sections 7 and 8, following.

Section 7: Primary Zone of Influence.

Certain watersheds will be designated by the Secretary under provisions of par 14(a)(11) of the Stormwater Management Acts as having impact upon the Delaware Estuary. Within these watersheds, the designated lands proximate to the Delaware Estuary within which runoff control BMPs will be required, are those draining into streams whose runoff, at mean flow conditions, drains to the Delaware Estuary in less than 40 hours. As one exception, flow from the Delaware River will be included upstream to the dam immediately downstream of New Hope, Pa. These watersheds will be known collectively as the primary zone of influence (Delaware Estuary). Other details relating to the delineation of the zone of influence may be specified in the interstate agreement.

Section 8: Best Management Practices for Control of Pollution (BMPs)

(a) General - The best management practices specified are designed for the removal of the greater portion of particulate pollution from stormwater runoff. The most important particulates removed include heavy metals, hydrocarbons, sediment, bacteria, and some forms of phosphorus. These best management practices are applicable to all improvements which will add at least 15,000 square feet of impervious surface. These practices require detention and slow release of runoff from the numerous small storms which carry most of the particulate pollution while control of the large storms may be provided in the interest of control of floods.

There are two levels of BMPs, standard and special. The selection of applicable BMPs is covered in the following section. These BMPs are technology-based, that is, although their objective is improved water quality, the BMPs are designed in terms of required structures and/or practices not mathematically related to water quality criteria. The required BMPs are described first in terms of dry detention basins (extended detention) followed by enumeration of alternative measures accomplishing an equivalent effect.



The basic method is described in ASCE/WPCF Publication No. 77, 1993, "The Design and Construction of Urban Stormwater Management Systems". It consists of prolonged detention of the relatively frequent smaller storms allowing particulates to settle with provisions for necessary flood control detention of the runoff from infrequent larger storms, if required. The selected small storm chosen for prolonged detention is called the "water quality design storm". For standard BMPs, the "water quality design storm" is a one year frequency 24-hour storm or, alternatively, a storm of 1¼ inches occurring in two hours. The water so impounded is to be 90 percent released in a period of 18 hours for residential development and 36 hours for non-residential development. For special BMPs, the water quality design storm is a one year frequency 24-hour storm and the 90 percent release time is 48 hours.

For very small detention basins where application of the above criteria for either standard or special BMPs would result in single orifice of less than 2 inches in diameter, the orifice shall be fixed at 2 inches in diameter and the time of detention reduced accordingly. In all cases, when orifices of less than 4 inches in diameter are used, a special engineering design to reduce the likelihood of plugging shall be employed, subject to approval by the municipality.

(b) **Detention Basins in Flood Plains** - No detention basins will be built in the floodway except for those on-stream. Detention basins elsewhere in the flood plain (the flood fringe) will not be built without a detailed engineering analysis to verify their adequacy of functioning during floods.

(c) **Basin Plans and Regional Facilities (BMPs)** - Usually the requirements for BMPs are applied separately to each development. However, a drainage basin planning approach can often provide an overall plan including at-site and regional facilities in a combination which reduces costs to individual developers while still achieving the desired results. In regional plans, particular care must be taken for provisions of facilities' maintenance. Regional plans may be adopted and applied by municipalities upon a determination that they will be equally effective to a site-by-site approach.

(d) **Alternatives (BMPs)** - Alternatives to dry detention basins include wet basins and infiltration basins which, if they meet requirements specified above, provide a higher degree of efficiency than dry detention basins, and can be accepted as meeting provisions of special BMPs (provided the permanent pool of the wet basin is at least equal in volume to the water quality storm runoff). Infiltration basins are only acceptable in cases in which it has been determined that infiltration of the runoff will not be unacceptable for groundwater quality.

Various BMPs other than detention can meet the designated requirements, subject to an engineering examination in order to verify the equivalence. Various at-site provisions such as swales, grass filter strips, dry wells, roof-top storage or source controls of pollutants alone or in combination with some provision of retention can provide effective results.

(e) **Selection of BMPs** - It is clear that BMPs for runoff control should not be applied across-the-board, but that the degree of control required depends on both the inherent





harmfulness of the proposed development in question and any special sensitivity of the area affected by the runoff.

New developments of Class 1 harmfulness are those inherently likely to contribute to runoff pollution. Proposed commercial and industrial facilities shall be considered Class 1 unless it is shown that impervious coverage will be below 50 percent that the type coverage and low vehicle use (such as warehouses) will assure relatively uncontaminated runoff and in either case, that the development will not contribute any inadequately treated wastewater or effluent. Housing developments with density of less than one third of an acre per housing unit, gasoline stations, state and county highways, and shopping centers are Class 1.

New commercial, industrial or housing developments excluded from Class 1 by the provisions of the preceding two sentences shall be Class 2. In cluster housing, the classification of the "cluster" as Class 1 may be compensated for by separate classification of the surrounding portions of the project.

For general classification purposes, the harmfulness index provides a useful guide to the environmental effects of any proposed land use when considered with respect to environmental sensitivity of the area affected downstream.

Class 1 new developments, where allowed, require special BMPs throughout the primary zone of influence, as well as a positive showing that the development will not contribute any inadequately treated wastewater or effluent. Class 2 new developments in general require only standard BMPs unless located within a half mile of a streamside or Estuary shore buffer strip established by this program, in which case special BMPs are required. By local ordinance, a local park, playground, or any natural resource area may be protected by requiring special BMPs for Class 2 new developments within that community draining into that area. For state- or Federal-designated sensitive areas, restricting development either inside or outside of the areas will be as required by state or Federal law.

(f) Especially restrictive provisions for new development are desirable in areas within 100-feet of the Delaware River shore or of the Neshaminy and Schuylkill Rivers, or within 50-feet of the other tributary streams identified in Section 7 above as draining the primary zone of influence. These areas will be known as buffer strips (Delaware Estuary Shore Buffer Strips and Streamside Buffer Strips). Within the buffer strips, no man-made structures should be built except water-related activities and other unavoidably necessary structures such as bridges. Any such structures should be individually justified and subject to approval as for a variance. Any disturbance of natural ground should leave the 20-feet adjacent to the river in natural vegetation or an unfertilized grass strip.

Section 9: Maintenance of Facilities for Runoff Pollution Control.

(a) All municipalities requiring construction of facilities for runoff pollution control shall require continued maintenance of such facilities in accordance with the following.



(b) In order to ensure proper maintenance and function of stormwater management facilities, the municipality or its designee shall perform inspections carried out on a random basis.

(c) If, at any time, the municipality or its designee discovers any violation or condition not conforming with those designs or plans filed with the municipality in regard to the operation of a stormwater management facility, it shall notify the responsible owners of the violation, informing them of the nature of such violation and the manner in which it can be corrected.

(d) Under no conditions shall any person be allowed to modify, alter, or change a previously approved stormwater management facility unless approved by the municipality.

(e) In the event the landowner or developer, or whatever the case may be, shall refuse or neglect to comply with the provisions of the Ordinance as interpreted by the municipality, the municipality may direct the work to correct any violation and charge the landowner or developer with the costs.

(f) In the event that the property is transferred to multiple ownerships, an owners association may be formed to carry out the maintenance for the entire development; but if there are uncorrected deficiencies, the various owners will be notified and after 60 days notice the township will carry out the work and the owners will be billed in amounts pro rata with the assessed valuation of their respective properties or other basis mutually agreed upon by the owners concerned, to reimburse the municipality for expenses in correcting the deficiencies.





### **APPENDIX 3:**

#### **PROPOSED DELAWARE ESTUARY PROTECTION ACT**

This proposed Delaware Estuary Protection Act represents new legislation that would be enacted by Delaware, New Jersey and Pennsylvania. Currently, it is written as an Act of the Commonwealth of Pennsylvania to provide limited protection of the Delaware Estuary from Stormwater pollution coming from new development and renovations in the state. This scope could be expanded to incorporate other Estuary-related protection needs, such as habitat. This approach demonstrates commitment of the Estuary states to the importance and protection of the Delaware Estuary and assures a complete and mandatory program, if enacted.







## **PROPOSED DELAWARE ESTUARY PROTECTION ACT**

The General Assembly of the Commonwealth of Pennsylvania hereby enacts as follows:

**Section 1:     Short title.**

This act shall be known and may be cited as the "Delaware Estuary Protection Act."

**Section 2:     Statement of legislative findings.**

The General Assembly finds that:

(1) A study of the Delaware Estuary conducted as part of the National Estuaries Program has shown that the Delaware Estuary is an economic, environmental and recreational resource of great value, but that it is threatened with increasing pollution, destruction of habitat, and resultant environmental degradation. A substantial and growing part of this pollution originates as nonpoint sources, in storm runoff from developed areas.

(2) This increase in runoff pollution can be arrested by requiring storm runoff best management practices to be applied to new development and redevelopments in areas close enough to the Estuary to contribute materially to this pollution.

(3) Wildlife habitat along the shores of the Estuary is particularly important including aquatic life, amphibians, and birds. In order to preserve this habitat as well as to reduce the risk of spills and pollution of the Estuary, it is desirable to restrict development in the immediate vicinity of the Estuary shore line, and of downstream portions of tributaries to the Estuary.

(4) The Estuary and its environment are a matter of regional as well as local significance, and the governments of the three states of Delaware, New Jersey and Pennsylvania have agreed to the desirability of an interstate agreement and regional program for the protection of the Estuary. Accordingly, except for necessary planning and preparations, no part of this legislation shall be applicable except in accordance with provisions of a tri-state agreement.

(5) The requirement for best management practices to control runoff pollution can be most efficiently provided for if done in conjunction with and at the same time as provision for flood water retardation by means of the Stormwater Management Act. However, if this is not feasible, the provisions of this Act shall be implemented as an early phase of storm water management. Any later storm water management planning shall be consistent with this Act.

**Section 3:     Purpose and Policy.**

The policy and purpose of this act is to:



(1) Outline the area of the Delaware River drainage within which runoff pollution is considered to be of sufficient importance to potential degradation of the Estuary to require imposition of best management practices, as a matter of priority, and also to require establishment of buffer strips immediately adjacent to shoreline, within which developments shall be restricted.

(2) Outline a program for delineation of buffer strips and imposition of best management practices upon developers.

(3) Establish procedures of proceeding with required best management practices in areas where stormwater management plans have been developed, as well as in areas in which stormwater management plans have not been developed.

Section 4: Definitions.

The following words and phrases when used in this act shall have, unless the context clearly indicates otherwise, the meanings given to them in this section:

*"Agency."* The agency of the Commonwealth of Pennsylvania to which implementation of the Act shall be entrusted.

*"BMP (Best Management Practices)."* Practices, procedures or structures required for the purpose of reducing pollution from runoff.

*"BMP Regulations."* Regulations issued in accordance with Section 6 of this act.

*"Buffer Strips."* Inclusive term for Delaware Estuary Shore Buffer Strips and Streamside Buffer Strips.

*"Delaware Estuary Shore Buffer Strips."* Areas adjacent to the shore of the Delaware Estuary within which certain limitations and controls on new development are required in order to limit pollution from storm runoff (see *Streamside Buffer Strips*).

*"Department."* The Department of Environmental Resources of the Commonwealth of Pennsylvania.

*"Municipality."* A city, borough, town or township, or any county or other governmental unit when acting as an agent thereof, or any combination thereof acting jointly.

*"Primary Zone of Influence of the Delaware Estuary."* Those watersheds and portions of watersheds considered most likely to impact the Estuary through runoff pollution.

*"Streamside Buffer Strips."* Areas adjacent to waterways within which certain limitations and controls on the developments are required in order to limit pollution from storm runoff (see *Delaware Estuary Shore Buffer Strips*).



*"Water Quality Aspects of Stormwater Management."* The application of stormwater management such as reduced pollution from runoff in addition to other goals of stormwater management.

Section 5:     Designated Watersheds.

In order to implement the provisions of the interstate agreement for the purpose of the Delaware Estuary Program, the Agency shall designate watersheds and delineate the primary zone of influence having impact on the environment and ecology of the Delaware Estuary for the purpose of determining BMPs and their implementation strategies applicable to new development and renovations. The watersheds designated shall be those from which any storm runoff drains into the Delaware Estuary within 40 hours under mean flow conditions, as determined by a survey conducted by this Agency. This survey is to be completed within one year after passage of the Act.

Section 6:     Regulations.

The Agency shall issue regulations applicable only within the watersheds designated as impacting the Delaware Estuary under provisions of Section 5 above. These shall be known as the BMP regulations (Delaware Estuary). Provisions of these regulations shall designate the portions of these watersheds where development is considered most likely to impact the Estuary through stormwater. These portions collectively shall be identified as the primary zone of influence for the Delaware Estuary. Within the primary zone of influence, the regulations shall require best management practices designated to minimize such impacts.

Section 7:     Buffer Strips.

Within the primary zone of influence, along the shores of the Delaware River, as far upstream as the dam below New Hope, Pa., and on both banks of other streams tributary there to, buffer strips shall be established. The strips shall be 100 feet wide, extending back from low water, on the Delaware River itself and on the portions of the Neshaminy and Schuylkill Rivers included in the primary zone of influence and 50 feet wide on other tributaries. Within the buffer strips, special provisions of best management practices shall be applicable as specified in the regulations.

Section 8:     Permits and Fees

In carrying out provisions of Sections 6 and 7, municipalities shall require permits for development and redevelopment under provisions of the regulations. Municipalities may charge a fee to developers representing the average cost to the municipalities of carrying out such provisions.

Section 9:     BMP Planning.

The counties having watersheds or portions thereof designated as within the primary zone of influence by the BMP Regulations (Delaware Estuary) shall undertake BMP





planning. For such areas as have an approved stormwater management plan, BMPs in accordance with this Act shall be required of developers as an addition to requirements for flood water retardation in the Stormwater Management Plan. If there is no such stormwater management plan or if there is delay in implementing such a plan, the BMPs shall be required of new development and redevelopment as specified in the BMP regulations, becoming effective in each case within two years after adoption of an interstate agreement requiring such a program. The county plan shall include a determination of which portions of each municipality are within the primary zone of influence (Delaware Estuary) and which of these portions are covered by an approved stormwater management plan. The plan shall also include a statement of the requirements for municipal ordinances to establish BMPs and buffer strips under this act. The county plan shall be issued within a year after adoption of the interstate agreement requiring such a program.

Section 10. Failure of municipalities to adopt Implementing ordinances.

- (a) If the Agency finds that a municipality has failed to adopt or amend and implement such ordinances and regulations as required by Section 11, the agency shall provide written notice of violation to the municipality.
- (b) Within 60 days of receipt of the notice of violation, the municipality shall report to the agency the action which it is taking to comply with the requirement or regulation.
- (c) If within 180 days of receipt of the notice of violation, the municipality has failed to comply with such requirement or regulation as determined by the Agency, the Agency shall notify the State Treasurer to withhold payment of all funds payable to the municipality from the General Fund. Provided, that prior to any withholding of funds, the Agency shall give both notice to the municipality of its intention to notify the State Treasurer to withhold payment of funds and the right to appeal the decision of the Agency within the 180-day period following notification. The hearing shall be conducted before the Environmental Hearing Board in accordance with the provisions of the act of April 9, 1929 (P.L. 177, No. 175), known as "The Administrative Code of 1929," and Chapters 5 and 7 of Title 2 (Administrative Law and Procedure), of the Pennsylvania Consolidated Statutes. If an appeal is filed within the 180-day period, funds shall not be withheld from the municipality until the appeal is decided.

Section 11: Civil remedies.

- (a) Any activity conducted in violation of the provisions of this act or of any watershed stormwater plan, regulations or ordinances adopted hereunder, is hereby declared a public nuisance.
- (b) Suits to restrain, prevent or abate violation of this act or of any watershed stormwater plan, regulations or ordinances adopted hereunder, may be instituted in equity or law by the Agency, any affected county or municipality, or any aggrieved person. Such proceedings may be prosecuted in the Commonwealth Court or in the court of common pleas of the county where the activity has taken place, the condition exists, or the public affected, and to that end jurisdiction is hereby conferred in law and equity upon such courts.



Except in cases of emergency where, in the opinion of the court, the circumstances of the case require immediate abatement of the unlawful conduct, the court may, in its decree, fix a reasonable time during which the person responsible for the unlawful conduct shall correct or abate the same. The expense of such proceedings shall be recoverable from the violator in such manner as may now or hereafter be provided by law.

(c) Any person injured by conduct which violates the provisions of Section 13 may, in addition to any other remedy provided under this act, recover damages caused by such violation from the landowner or other responsible person.

Section 12: Preservation of existing rights and remedies.

(a) The collection of any penalty under the provisions of this act shall not be construed as stopping the Commonwealth, any county, municipality or aggrieved person from proceeding in courts of law or equity to abate nuisances under existing law or to restrain, at law or in equity, violation of this act.

(b) It is hereby declared to be the purpose of this act to provide additional and cumulative remedies to abate nuisances.

Section 13: Appropriations

There is hereby appropriated the sum of \$\_\_\_\_\_ to defray expenses of the survey required by Section 5, initial costs to municipalities of passing required ordinances and other expenses in implementing provisions of this Act.

Section 14: Effective Date.

This act shall be effective immediately.

(End of Act)





#### **APPENDIX 4:**

### **PROPOSED REGULATIONS - DELAWARE ESTUARY PROTECTION ACT**

A regulatory approach to implementation of the proposed Delaware Estuary Protection Act is recommended. Proposed regulations are presented in this Appendix.







## **PROPOSED BEST MANAGEMENT PRACTICES (BMP) REGULATIONS (DELAWARE ESTUARY)**

### **Section 1: Authority.**

These regulations are issued pursuant to Section 6 of the Delaware Estuary Protection Act.

### **Section 2: Short Title.**

These regulations may be known as the BMP Regulations (Delaware Estuary).

### **Section 3: Coordination With Other Stormwater Management Plans.**

Section 5(a)(b) and (c) of the Stormwater Management Act calls for county plans for flood retardation which, however, needs not include any provisions for maintaining water quality of receiving waters. The BMP Regulations (Delaware Estuary) require plans specifically designed for maintenance of water quality of receiving waters, but without any specific provisions for flood retardation. It is advantageous and economical to combine both programs into a combined approach, if both are to be done. However, in the event that funding for a more complete stormwater management approach is lacking in any given area, the provisions of these regulations shall be implemented separately as an initial step. In any subsequent stormwater management planning, the provisions of these regulations will be complied with.

### **Section 4: Purpose.**

These regulations require county and local authorities to implement measures to prevent water quality degradation associated with storm runoff from land development activities, as necessary to protect the Delaware Estuary, in accordance with a proposed interstate agreement. They provide a technology-based approach to minimizing runoff pollution from new development, by means of best management practices in storm water management.

### **Section 5: Definitions**

*"Best Management Practices."* Practices, procedures or structures required for the purpose of reducing pollution from runoff.

*"Delaware Estuary Shore Buffer Strips."* Areas adjacent to the shore of the Delaware Estuary within which certain limitations and controls on new development are required in order to limit pollution from storm runoff (see *Streamside Buffer Strips*).

*"Primary Zone of Influence."* Those watersheds and portions of watersheds considered most likely to impact the Estuary through runoff pollution.



*"Streamside Buffer Strips."* Areas adjacent to waterways within which certain limitations and controls on new developments are required in order to limit pollution from storm runoff (see *Delaware Estuary Shore Buffer Strips*).

*"Water Quality Aspects of Stormwater Management."* The application of stormwater management such as to reduce pollution from runoff in addition to other goals of stormwater management.

Section 6: Runoff Pollution Control (Delaware Estuary Drainage)

Municipal ordinances shall require that all new developments and redevelopments which will involve construction of more than 15,000 square feet of additional impervious surface in designated lands proximate to the Delaware Estuary, as described in Section 7 below, shall apply certain best management practices for reduction of runoff pollution. The municipality may charge an appropriate fee for permitting such construction in an amount approximating the pro rata cost of administration of the regulations. Similar best management practices will be required of construction by municipalities, counties, authorities, or divisions, bureaus, boards or agencies of the Commonwealth. Such best management practices are described in Sections 7 and 8, following. Agencies other than municipalities will issue their own permits, including a determination that the construction authorized complies with these regulations.

Section 7: Primary Zone of Influence.

Certain watersheds will be designated by the Secretary under provisions of par 14(a)(11) of the Stormwater Management Acts as having impact upon the Delaware Estuary. Within these watersheds, the designated lands proximate to the Delaware Estuary within which runoff control BMPs will be required, are those draining into streams whose runoff, at mean flow conditions, drains to the Delaware Estuary in less than 40 hours. As one exception, flow from the Delaware River will be included upstream to the dam immediately downstream of New Hope, Pa. These watersheds will be known collectively as the primary zone of influence (Delaware Estuary). Other details relating to the delineation of the zone of influence may be specified in the interstate agreement.

Section 8: Best Management Practices for Control of Pollution (BMPs)

(a) General - The best management practices specified are designed for the removal of the greater portion of particulate pollution from stormwater runoff. The most important particulates removed include heavy metals, hydrocarbons, sediment, bacteria, and some forms of phosphorus. These best management practices are applicable to all improvements which will add at least 15,000 square feet of impervious surface. These practices require detention and slow release of runoff from the numerous small storms which carry most of the particulate pollution, while control of the large storms may be provided in the interest of control of floods.

There are two levels of BMPs, standard and special. The selection of applicable BMPs is covered in the following section. These BMPs are technology-based, that is,



although their objective is improved water quality, the BMPs are designed in terms of required structures and/or practices not mathematically related to water quality criteria. The required BMPs are described first in terms of dry detention basins (extended detention) followed by enumeration of alternative measures of accomplishing an equivalent effect.

The basic method is described in ASCE/WPCF Publication No. 77, 1993, *The Design and Construction of Urban Stormwater Management Systems*". It consists of prolonged detention of the relatively frequent smaller storms allowing particulates to settle with provisions for necessary flood control detention of the runoff from infrequent large storms, if required. The selected small storm chosen for prolonged detention is called the "water quality design storm". For standard BMPs, the "water quality design storm" is a one year frequency 24-hour storm or, alternatively, a storm of 1¼ inches occurring in two hours. The water so impounded is to be 90 percent released in a period of 18 hours for residential development and 36 hours for non-residential development. For special BMPs, the water quality design storm is a one year frequency 24-hour storm and the 90 percent release time is 48 hours.

For very small detention basins where application of the above criteria for either standard or special BMPs would result in single orifice of less than 2 inches in diameter, the orifice shall be fixed at 2 inches in diameter and the time of detention reduced accordingly. In all cases, when orifices of less than 4 inches in diameter are used, a special engineering design to reduce the likelihood of plugging shall be employed, subject to approval by the municipality.

(b) **Detention Basins in Flood Plains** - No detention basins will be built in the floodway except for those on-stream. Detention basins elsewhere in the flood plain (the flood fringe) will not be built without a detailed engineering analysis to verify adequacy of their functioning during floods.

(c) **Basin Plans and Regional Facilities (BMPs)** - Usually the requirements for BMPs are applied separately to each development. However, a drainage basin planning approach can often provide an over-all plan including at-site and regional facilities in a combination which reduces costs to individual developers while still achieving the desired results. In regional plans, particular care must be taken for provisions of facilities' maintenance. Regional plans may be adopted and applied by municipalities, upon a determination that they will be equally effective to a site-by-site approach.

(d) **Alternatives (BMPs)** - Alternatives to dry detention basins include wet basins and infiltration basins which, if they meet requirements specified above, provide a higher degree of efficiency than dry detention basins, and can be accepted as meeting provisions of special BMPs (provided the permanent pool of the wet basin is at least equal in volume to the water quality storm runoff). Infiltration basins are only acceptable in cases in which it has been determined that infiltration of the runoff will not be unacceptable for groundwater quality.

Various BMPs other than detention can meet the designated requirements, subject to an engineering examination in order to verify the equivalence. Various at-site provisions





such as swales, grass filter strips, dry wells, roof-top storage or source controls of pollutants alone or in combination with some provision of retention can provide effective results.

(e) Selection of BMPs - It is clear that BMPs for runoff control should not be applied across-the-board, but that degree of control required depends on both the inherent harmfulness of the proposed development in question and any special sensitivity of the area affected by the runoff.

New developments of Class 1 harmfulness are those inherently likely to contribute to runoff pollution. Proposed commercial and industrial facilities shall be considered Class 1 unless it is shown that impervious coverage will be below 50 percent or that the type coverage and low vehicle use (such as warehouses) will assure relatively uncontaminated runoff and in either case, that the development will not contribute any inadequately treated wastewater or effluent. Housing developments with density of less than one third of an acre per housing unit, gasoline stations, state and county highways, and shopping centers are Class 1.

New commercial, industrial or housing developments excluded from Class 1 by the provisions of the preceding two sentences shall be Class 2. In cluster housing, the classification of the "cluster" as Class 1 may be compensated for by separate classification of the surrounding portions of the project.

For general classification purposes, the harmfulness index provides a useful guide to the environmental effects of any proposed land use when considered with respect to environmental sensitivity of the area affected downstream.

Class 1 new developments, where allowed, require special BMPs throughout the primary zone of influence as well as a positive showing that the development will not contribute any inadequately treated wastewater or effluent. Class 2 new developments generally require only standard BMPs unless located within a half mile of a streamside or Estuary shore buffer strip established by this program, in which case special BMPs are required. By local ordinance, a local park, playground, or any natural resource area may be protected by requiring special BMPs for Class 2 new developments within that community draining into that area. For state- or Federal-designated sensitive areas, restricting development either inside or outside of the areas will be as required by state or Federal law.

(f) In accordance with provisions of Section 4 of the Delaware Estuary Protection Act, especially restrictive provisions for new development are required in buffer strips, which are in areas within 100-feet of the Delaware River shore or of the Neshaminy and Schuylkill Rivers, within 50-feet of the other tributary streams identified in Section 7 above as draining the primary zone of influence, or within 50 feet of legislatively established wetlands. Within the buffer strips, no man-made structures will be allowed except water-related activities and other unavoidably necessary structures such as bridges. Any such structures shall be individually justified and subject to approval as for a variance. Any disturbance of natural ground shall leave the 30-feet adjacent to the river in natural vegetation or an unfertilized grass strip.



Section 9: Maintenance of Facilities for Runoff Pollution Control.

- (a) All municipalities requiring construction of facilities for runoff pollution control shall require continued maintenance of such facilities in accordance with the following.
- (b) In order to ensure proper maintenance and function of stormwater management facilities, the municipality or its designee shall perform inspections carried out on a random basis.
- (c) If, at any time, the municipality or its designee discovers any violation or condition not conforming with those designs or plans filed with the municipality in regard to the operation of a stormwater management facility, it shall notify the responsible owners of the violation, informing them of the nature of such violation and the manner in which it can be corrected.
- (d) Under no conditions shall any person be allowed to modify, alter, or change a previously approved stormwater management facility unless approved by the municipality.
- (e) In the event the landowner or developer, or whatever the case may be, shall refuse or neglect to comply with the provisions of the Ordinance as interpreted by the municipality, the municipality may direct the work to correct any violation and charge the landowner or developer with the costs.
- (f) In the event that the property is transferred to multiple ownerships, an owners association may be formed to carry out the maintenance for the entire development; but if there are uncorrected deficiencies, the various owners will be notified and after 60 days notice the township will carry out the work and the owners will be billed in amounts pro rata with the assessed valuation of their respective properties or other basis mutually agreed upon by the owners concerned, to reimburse the municipality for expenses in correcting the deficiencies.





**APPENDIX 5:**

**PROPOSED GUIDANCE -- DELAWARE ESTUARY  
PROTECTION AGAINST RUNOFF POLLUTION**







## PROPOSED GUIDANCE -- DELAWARE ESTUARY PROTECTION AGAINST RUNOFF POLLUTION

### Section 1: Scope

This guidance is issued pursuant to authority of the Stormwater Management Act. Its purpose is to encourage voluntary action by municipalities and other agencies to reduce future increases of runoff pollution in the Delaware Estuary from new development and major redevelopment. It is applicable in areas defined in Section 7 as the primary Zone of influence, Delaware Estuary.

### Section 2: Short Title

This guidance may be known as the Delaware Estuary Runoff Guidance.

### Section 3: Coordination With Stormwater Management Plans

Section 5(a)(b) and (c) of the Stormwater Management Act calls for county plans and for flood retardation which, however, needs not include any provisions for maintaining water quality of receiving waters. This guidance encourages plans specifically designed for maintenance of water quality of receiving waters, but without any specific provisions for flood retardation. It is advantageous and economical to combine both programs into a combined approach, if both are to be done. However, in the event that funding for a more complete stormwater management approach is lacking in any given area, the provisions of this guidance may be implemented separately as an initial step.

### Section 4: Purpose.

This guidance encourages county and local authorities to implement measures to prevent water quality degradation associated with storm runoff from land development activities, as necessary to protect the Delaware Estuary, in accordance with a proposed interstate agreement. They provide a technology-based approach to minimizing runoff pollution from new development by means of best management practices in storm water management.

### Section 5: Definitions

*"Best Management Practices."* Practices, procedures or structures used for the purpose of reducing pollution from runoff.

*"Delaware Estuary Shore Buffer Strips."* Areas adjacent to the shore of the Delaware Estuary within which certain limitations and controls on new development are desirable in order to limit pollution from storm runoff (see *Streamside Buffer Strips*).

*"Primary Zone of Influence."* Those watersheds and portions of watersheds considered most likely to impact the Delaware Estuary through runoff pollution.



*"Streamside Buffer Strips."* Areas adjacent to waterways within which certain limitations and controls on new developments are desirable in order to limit pollution from storm runoff (see *Delaware Estuary Shore Buffer Strips*).

*"Water Quality Aspects of Stormwater Management."* The application of stormwater management such as to reduce pollution from runoff in addition to other goals of stormwater management.

Section 6: Runoff Pollution Control (Delaware Estuary Drainage)

In order to achieve the desired objective, municipal ordinances should require that all new developments and redevelopments which will involve construction of more than 15,000 square feet of additional impervious surface in designated lands proximate to the Delaware Estuary, as described in Section 7 below, shall apply certain best management practices for reduction of runoff pollution. The municipality should charge an appropriate fee for permitting such construction in an amount approximating the pro rata cost of administration of the regulations. Similar best management practices are encouraged for construction by municipalities, counties, authorities, or divisions, bureaus, boards or agencies of the Commonwealth. Such best management practices are described in Sections 7 and 8, following. Agencies other than municipalities will issue their own permits, including a determination that the construction authorized complies with these regulations.

Section 7: Primary Zone of Influence.

Certain watersheds have material impact upon the Delaware Estuary. Within these watersheds, the designated lands proximate to the Delaware Estuary within which runoff control BMPs are encouraged are those draining into streams whose runoff, at mean flow conditions, drains to the Delaware Estuary in less than 40 hours. As one exception, flow from the Delaware River should be included upstream to the dam immediately downstream of New Hope, Pa. These watersheds will be known collectively as the Primary Zone of Influence (Delaware Estuary).

Section 8: Best Management Practices for Control of Pollution (BMPs)

(a) General - The best management practices specified are designed for the removal of the greater portion of particulate pollution from stormwater runoff. The most important particulates removed include heavy metals, hydrocarbons, sediment, bacteria, and some forms of phosphorus. These best management practices are applicable to all improvements which will add at least 15,000 square feet of impervious surface. These practices require detention and slow release of runoff from the numerous small storms which carry most of the particulate pollution while control of the large storms may be provided in the interest of control of floods.

There are two levels of BMPs, standard and special. The selection of applicable BMPs is covered in the following section. These BMPs are technology-based, that is, although their objective is improved water quality, the BMPs are designed in terms of required structures and/or practices not mathematically related to water quality criteria. The



BMPs are described first in terms of dry detention basins (extended detention) followed by enumeration of alternative measures of accomplishing an equivalent effect.

The basic method is described in ASCE/WPCF Publication No. 77, 1993, *The Design and Construction of Urban Stormwater Management Systems*. It consists of prolonged detention of the relatively frequent smaller storms, allowing particulates to settle, with provisions for necessary flood control detention of the runoff from infrequent large storms, if required. The selected small storm chosen for prolonged detention is called the "water quality design storm". For standard BMPs, the "water quality design storm" is a one year frequency 24-hour storm or, alternatively, a storm of 1¼ inches occurring in two hours. The water so impounded is to be 90 percent released in a period of 18 hours for residential development and 36 hours for non-residential development. For special BMPs, the water quality design storm is a one year frequency 24-hour storm and the 90 percent release time is 48 hours.

For very small detention basins where application of the above criteria for either standard or special BMPs would result in single orifice of less than 2 inches in diameter. The orifice shall be fixed at 2 inches in diameter and the time of detention reduced accordingly. In all cases, when orifices of less than 4 inches in diameter are used, a special engineering design to reduce the likelihood of plugging shall be employed, subject to approval by the municipality.

(b) Detention Basins in Flood Plains - No detention basins should be built in the floodway except for those on-stream. Detention basins elsewhere in the flood plain (the flood fringe) should not be built without a detailed engineering analysis to verify adequacy of their functioning during floods.

(c) Basin Plans and Regional Facilities (BMPs) - Usually the requirements for BMPs are applied separately to each development. However, a drainage basin planning approach can often provide an overall plan including at-site and regional facilities in a combination which reduces costs to individual developers while still achieving the desired results. In regional plans, particular care must be taken for provisions of facilities' maintenance. Regional plans may be adopted and applied by municipalities upon a determination that they will be equally effective to a site-by-site approach.

(d) Alternatives (BMPs) - Alternatives to dry detention basins include wet basins and infiltration basins which, if they meet requirements specified above, provide a higher degree of efficiency than dry detention basins and can be accepted as meeting provisions of special BMPs (provided the permanent pool of the wet basin is at least equal in volume to the water quality storm runoff). Infiltration basins are only acceptable in cases in which it has been determined that infiltration of the runoff will not be unacceptable for groundwater quality.

Various BMPs other than detention can meet the designated requirements, subject to an engineering examination in order to verify the equivalence. Various at-site provisions such as swales, grass filter strips, dry wells, roof-top storage or source controls of pollutants alone or in combination with some provision of detention can provide effective results.





(e) Selection of BMPs - It is clear that BMPs for runoff control should not be applied across-the-board but that the degree of control required depends on both the inherent harmfulness of the facility in question and any special sensitivity of the area affected by the runoff.

New developments of Class 1 harmfulness are those inherently likely to contribute to runoff pollution. Proposed commercial and industrial facilities shall be considered Class 1 unless it is shown that impervious coverage will be below 50 percent or that the type coverage and low vehicle use (such as warehouses) will assure relatively uncontaminated runoff and in either case, that the development will not contribute any inadequately treated wastewater or effluent. Housing developments with density of less than one third of an acre per housing unit, gasoline filling stations, state and county highways, and shopping centers are Class 1.

New commercial, industrial or housing new developments excluded from Class 1 by the provisions of the preceding two sentences shall be Class 2. In cluster housing, the classification of the "cluster" as Class 1 may be compensated for by separate classification of the surrounding portions of the project. For general classification purposes, the harmfulness index provides a useful guide to the environmental effects of any proposed land use when considered with respect to environmental sensitivity of the area affected downstream.

Class 1 new developments, where allowed, should have special BMPs throughout the Primary Zone of Influence as well as a positive showing that the development will not contribute any inadequately treated wastewater or effluent. Class 2 new developments in general require only standard BMPs unless located within a half mile of a streamside or Estuary shore buffer strip established by this program, in which case special BMPs are required. By local ordinance, a local park, playground, or any natural resource area may be protected by requiring Special BMPs for Class 2 new developments within that community draining into that area. For state- or Federal-designated sensitive areas, restricting development either inside or outside of the areas will be as required by state or Federal law.

(f) Especially restrictive provisions for new development are desirable in areas within 100-feet of the Delaware River shore or of the Neshaminy and Schuylkill Rivers, or within 50-feet of the other tributary streams identified in Section 7 above as draining the primary zone of influence. These areas will be known as buffer (Delaware Estuary Shore Buffer Strips and Streamside Buffer Strips). Within the buffer strips, no man-made structures should be built except water-related activities and other unavoidably necessary structures such as bridges. Any such structures should be individually justified and subject to approval as for a variance. Any disturbance of natural ground should leave the 20-feet adjacent to the river in natural vegetation or an unfertilized grass strip.

Section 9: Maintenance of Facilities for Runoff Pollution Control.

(a) All municipalities requiring construction of facilities for runoff pollution control should require continued maintenance of such facilities in accordance with the following.



(b) In order to ensure proper maintenance and function of stormwater management facilities, the municipality or its designee should perform inspections carried out on a random basis.

(c) If, at any time, the municipality or its designee discovers any violation or condition not conforming with those designs or plans filed with the municipality in regard to the operation of a stormwater management facility, it should notify the responsible owners of the violation, informing them of the nature of such violation and the manner in which it can be corrected.

(d) Under no conditions should any person be allowed to modify, alter, or change a previously approved stormwater management facility unless approved by the municipality.

(e) In the event the landowner or developer, or whatever the case may be, should refuse or neglect to comply with the provisions of the ordinance as interpreted by the township, the township should direct the work to correct any violation and charge the landowner or developer to reimburse the costs.

(f) In the event that the property is transferred to multiple ownerships, an owners association may be formed to carry out the maintenance for the entire development; but if there are uncorrected deficiencies, the various owners should be notified and after 60 days notice the township should carry out the work and the owners be billed in amounts pro rata with the assessed valuation of their respective properties or other basis mutually agreed upon by the owners concerned, to reimburse the municipality for expenses in correcting the deficiencies.





**APPENDIX 6:**  
**EFFECTIVENESS OF BMPS**







## APPENDIX 6 EFFECTIVENESS OF BMPs

### Stormwater Management Water Quality Provisions

Analysts of stormwater management generally agree that regional or watershed planning will provide better results than piecemeal development which provides for each development site as it is built. However, the latter, called the site-by-site approach, is the one generally used (note that the site-by-site approach usually requires detention storage as well as at-site facilities). In the site-by site approach, the developer, as a condition for obtaining approval of his proposal, is required to assume responsibility for remedial works designed to counter the accumulated flood flows and added stormwater pollution which will result from his construction. Much better results can be arrived at by means of an integrated plan for the watershed as a whole, but this requires more complex funding mechanisms and planning arrangements and a sharing of responsibility. From the point of view of protecting the Estuary, either regional planning or a site-by-site approach can provide an adequate answer.

Stormwater from developing and developed areas characteristically contains various contaminants in environmentally damaging amounts, unacceptable to both ground and surface waters used for water supply. Heavy metals, hydrocarbons, nutrients, and bacterial contamination are important constituents requiring attention.

In stormwater management, water quality control is usually obtained through dual-purpose detention basins designed first, to reduce flood damages downstream and second, to reduce nonpoint source pollution from storm runoff. Although they are similar in appearance to the much earlier sediment control and flood retention dams of the U.S. Soil Conservation Service, the idea of using stormwater detention basins to reduce



environmental pollution in streams of urbanizing areas first gained recognition through Section 208 (of PL92-500, the Federal Water Pollution Control Act) water quality planning studies started in 1972.<sup>1</sup>

The underlying principle of dual-purpose detention is that the detention of flood flows for reduction of damages downstream and the retardation of stormwater for settlement of particulates can advantageously be combined in the same structure. Flood damages are almost entirely due to a few large floods, whereas the harmful pollution effects occur mainly as the cumulative effect of a large number of small storms. Storage of the runoff from storms of up to one year frequency (or 1 1/4 inches rainfall in 2 hours) with slow release over periods of 18 to 36 hours, in either dry or wet ponds, can reduce total contaminants by well over half for lead, hydrocarbons and for total suspended sediment and can achieve somewhat lower, but still substantial, removal efficiencies for phosphates, bacteria and other contaminants. This degree of control is established as a criterion by the New Jersey Stormwater Management Act regulations. Similar standards have been recommended or used in other states, sometimes with smaller water quality design storms recommended. Somewhat greater efficiencies can be obtained by special inlet weirs which channel only the first flush of runoff to the detention basin, so that for the larger storms, the more polluted first flush runoff is not diluted prior to settlement. If a small design storm, say of only one or two months frequency, is used, the special inlet weirs probably need to be provided. Whatever the criteria used the storage should include an allowance for accumulation of sediment within the basin for at least a 50-year period. There is still a variety of opinions as to exactly the best criteria; but there is a substantial professional consensus that prolonged detention of runoff from the more frequent storms will achieve a substantial improvement in water quality. The characteristics of the particulates in the runoff and other local characteristics may somewhat affect the efficiency of the basin. A design providing for retention of particulates as described above can be accepted as providing standard best management practices.<sup>2</sup> This will provide a proportionate reduction in BOD, lead and hydrocarbons and a

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<sup>1</sup> There is an extensive literature on the use of detention basins for control of pollution. The matter has been summarized and details made specific in Chapter 11 of a manual of practice published jointly by ASCE/WEF: "Design and Construction of Urban Stormwater Management Systems," ASCE Manual 77, 1992.



somewhat lower but still substantial reduction in phosphorus and coliform bacteria. Oil storage facilities, oil transfer points or other facilities where there is considerable risk of spillage should also have oil separators.

A higher degree of removal of particulates can be provided by infiltration (see the following section) by wet ponds having a capacity below the outlet equalling twice the volume of the water quality design storm, or by storage in detention basins of the one year, 24-hour storm, with slow release over a 48-hour period. Any of these alternatives can be accepted as comprising special best management practices for removing particulate pollution.

It must be borne in mind that standard and special best management practices using detention basins relate to ordinary development with normal erosion control, and they are not sufficient for the more polluted kinds of industrial runoff. In such cases, source controls or treatment may also be needed. Recommended practices for particulate removal are not, of course, applicable to removal of nitrates.

There are circumstances in which stormwater detention basins may be built for water quality control only. Water quality needs are especially acute in coastal areas. Many small watersheds draining into tidal waters are not greatly affected by fluvial floods. However, the bays and estuaries into which these streams drain are often environmentally fragile and may be seriously affected by contaminants which the stormwater from developed areas may contain. In such cases, it may be unnecessary to require developers to provide detention storage to reduce peak storm flows. The prolonged retention and sedimentation of runoff from small storms, such as the one-year frequency storm, will greatly reduce the adverse water quality impact of storm runoff in such cases. In areas close to the Estuary shores, particulate removal by detention basins may advantageously be supplemented by "minimum disturbance -minimum maintenance" vegetation, which minimizes water runoff of sediment in general and especially of nutrients. Where such plantings are used, further water quality provisions need only be planned for runoff from buildings and impervious surfaces.

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<sup>2</sup> See Chapter 12 of manual of practice, jointly published by ASCE/WEF: "Design and Construction of Urban Stormwater Management Systems," ASCE Manual 77, 1992.





In many areas of New Jersey and Pennsylvania, stormwater management is not required for new developments. In such cases, the required control of runoff pollution can be accomplished by providing detention facilities designed to store and slowly release runoff from only the small storms. This relatively small amount of detention storage can often be provided by swales or other at-site provisions. From the overall planning viewpoint, the dual purpose detention basins are preferable, but if there is no requirement to provide for flood hazard mitigation, it may be necessary to proceed with runoff pollution control alone.

### **Infiltration Facilities**

Infiltration facilities may be of a variety of configurations, infiltration basins being the most common. Unless dealing with clear runoff (i.e., rooftops), they must incorporate means to maintain infiltration capacity. This can be done by a two-stage facility in which the sediment is allowed to precipitate out in a non-filtering first stage or by arrangements allowing infiltration into relatively steep sides of the basin. Alternatively, special arrangements can be made for periodic maintenance by cleaning out the bottom of the basins, but such maintenance must be assured on a permanent basis. Dry wells and infiltration trenches should only be used for runoff lacking sediment, such as rooftop drainage or thoroughly settled discharge from a retention facility.

Experience with infiltration basins in coastal areas has not been very favorable. In Virginia, they have been considered to have relatively low reliability and high maintenance costs (Aldrich, et al., 1988). Difficulty has also been encountered in New Jersey coastal areas. In some cases, suitable soils are not found, and unless normal groundwater is at least four feet below the bottom of the basin, infiltration action is apt to be suspended due to mounding, resulting in insect problems and impaired retention. As a first stage of detention, prior to infiltration, it may be necessary to provide for settlement in a lined detention basin with the settled runoff then being processed through an infiltration basin.

Infiltration basins are excellent from the viewpoint of instream water quality, since no sediments are released downstream. They are not effective in removing soluble substances, especially nitrates, but can be accepted as a special best management practice for NPS pollution in general. However, they must be used



only where soils are sufficiently permeable, where no ground water quality problem is involved, and where normal ground water is at least four feet below the bottom of the basin.

Artificial wetlands and spray irrigation can be very effective in nitrate removal. Deep wet ponds are excellent for removal of most pollutants. They have been found effective in denitrification on an experimental basis, but criteria for success have not been fully developed. Artificial wetlands and spray irrigation can be accepted as special best management practices for NPS pollution, but only after a careful technical review in each case. The Federal coastal zone management program was established by Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 for the purpose of implementing economically achievable measures to control the addition of pollutants to our coastal waters. States are required to develop and implement coastal nonpoint pollution control programs for this purpose under guidance by Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidelines, published jointly by EPA and NOAA. For sites the runoff of which contains hazardous substances, treatment of runoff may be required.

### **Site Controls**

Site controls are generally those controls that attempt to reduce runoff rates and volume at or near the point where the rainfall hits the ground surface. They have the effect of reducing NPS pollution in runoff and are introduced through land use planning processes. The following types of site controls are common:

- Minimization of directly connected impervious area
- Swales and filter strips
- Porous pavement and paving blocks
- Infiltration devices, such as trenches and basins.

### **Minimization of Directly Connected Impervious Area**

Directly connected impervious area (DCIA) is defined as the impermeable area that drains directly to the improved drainage system, i.e., paved gutter, improved ditch, or pipe. The minimization of DCIA is an effective method of runoff quality control, because it delays the concentration of flows into the improved drainage system and maximizes the opportunity for rainfall to infiltrate at or near the point at which it strikes the ground.



Although streets without curbs, which minimize DCIA, are environmentally desirable, a maintenance problem arises. Runoff from the street flows onto bordering grassy areas. Over time, as cars drive or park off the asphalt pavement, the edges begin to break up, and the grass either pushes out into the asphalt or is destroyed by the weight of the vehicles driving off the pavement. One way to reduce these problems without inhibiting infiltration is to provide a one-foot wide concrete border along the edge of the street. At intersections a curb can be installed that turns the radius of the corner.

Minimization of directly connected impervious areas can be obtained by land use planning controls and by discouraging installation of curbs and gutters where none now exist.

### **Swales and Filter Strips**

Swales, or grassed waterways, and filter strips are among the oldest stormwater control measures, having been used alongside streets and highways for many years. A swale is a shallow trench which has the following characteristics:

- the side slopes are flatter than three feet horizontally to one foot vertically;
- it contains contiguous areas of standing or flowing water only following rainfall;
- it is planted with or contains vegetation suitable for soil stabilization, stormwater treatment, and nutrient uptake.

A filter strip is simply a strip of land, usually 20 feet or more in width, of mild slope across which stormwater from a street, parking lot, rooftop, etc., flows before entering adjacent receiving waters. Even distribution of flow is essential.

For small storms, both swales and filter strips remove pollutants from stormwater by first slowing the water and settling or filtering out solids as the water travels over the grassed area and secondly, allowing infiltration into the underlying soil. In general, the higher the flow rate, the lower the efficiency. Thus, low velocity and shallow depth are key design criteria. A swale designed with a low bottom slope and check dams will perform much more efficiently than one without check dams. For maximum efficiency of pollutant removal during small storms, a trapezoidal swale with as large a bottom width as can be fitted into the site plan



is desirable, since this will maximize the amount of runoff in contact with the vegetation and soil. For effective results, filter strips are designed for sheet flow over grass.

Maintenance of both of these devices is an important consideration for reasons of both aesthetics and hydraulic efficiency. In the case of the swale, care must be taken to insure that flows through a swale used for drainage purposes during large storms are not impeded by an overgrowth of vegetation. To prevent this, the vegetation planted in the channel should be suitable for mowing and the channel designed so that mowing machines can be easily and efficiently operated along the swale. Of course, the swale should be mowed on a regular basis. For filter strips which are not part of the drainageway during large storms, maintenance is purely an aesthetic matter. These strips can be planted in grass and mowed or natural vegetation can be used. Any ground cover, however, must be sufficiently dense to keep the overland flow from channelizing and eroding rivulets through the filter strip.

Porous pavement and paving blocks can be used to provide infiltration on streets and in parking areas. However, porous pavement is only feasible on sites with permeable soils, fairly flat slopes, and relatively deep water-table and bedrock levels. In addition, batching and placement of the material requires special expertise in order to avoid clogging, which is a principal concern associated with porous pavement. The risk of clogging is high and once it has occurred, it is difficult and costly to correct. The chief means of preventing the problem is to keep sediment off the underlying soil before construction and off the pavement during and after construction.

Porous pavement is being used fairly extensively as a viable alternative in Florida. However, outside of the sunbelt area, additional consideration should be given to the structural integrity of porous pavement under winter freeze-thaw conditions.

Another effective site-control device is paving blocks (Pratt, 1990). These are hollow concrete blocks similar to, but smaller than, those used in construction. In parking lots for retail stores, sports arenas and civic theaters, where more than half of the parking is used less than 20 percent of the time, the use of parking blocks





in the less-used portions of such lots gives them a more attractive appearance and will considerably reduce runoff quantity, flow rates, and pollution from these areas.

### **Site Controls as BMP**

In planning or approving a stormwater management system, the necessary water quality controls may be imposed at site or through detention basins. For the detention facilities alone, the requirements are well-defined, whether a standard or a special degree of protection is required. When not precluded by ground water quality restrictions, infiltration facilities which allow percolation of the water quality design storm are acceptable as special BMPs for pollutant removal. Either standard or special NPS control at-site can be provided by other means, such as filter strips and swales, but efficiency of removal depends upon design details. Therefore, in such cases, an engineering analysis must be made for each site to assure that it will actually function as intended.

In general, the requirements for curtailing pollution from a new development (or redevelopment) can be met by a combination of preventive and remedial works. The preventive aspects of control such as filter strips, roof drains, etc. may be combined with remedial work such as stormwater detention facilities so that the preventive aspects might justify reducing the detention requirement from "special" to "standard" or might compensate for a part of the site not draining into the detention facilities.

### **On-Site Wastewater Treatment**

Septic tanks and other on-site wastewater treatment are a long established means of family waste disposal in rural areas. They are designed to remove 30 to 40 percent of BOD and most solids, including phosphates. Removal of nitrates is much less effective. Unfortunately, certain volatile organics which are carcinogenic in very small concentrations are also not removed by normal septic tank operation. Protection of ground water is the usual problem. Technical criteria for siting and maintenance of septic systems are available. Applicable regulatory authority should prevent use of on-site wastewater treatment systems other than in accordance with established criteria. Special precautions which can be taken include either treatment



of effluent or separating out toilet wastes and hauling them away for treatment (Coastal NPS Guidance). As regards protection of the Estuary, the main objective is to prevent siting of septic systems in the immediate vicinity of the shore.

### **Marinas**

Marinas are subject to Corps of Engineers Section 404 permits for filling, boats' sewage is regulated under Section 312 of the Clean Water Act, and in Delaware marinas require special permits from the state with provisions in the interest of water quality. The coastal NPS guidance includes specific management measures regarding control of runoff from marinas. Detention is required of the first one-half inch of runoff from the entire property for floods up to the ten-year, 24-hour frequency with the retained flows being released gradually over 24 hours. This provision for removal of particulate pollution probably has the effectiveness of a special BMP, as previously indicated in Section 7.4.

### **Summary**

There are many available techniques for preventing damage from NPS pollution. Special controls may be needed for marinas, septic tanks, hazardous waste sites and major nitrogen sources. However, for land use management control of most NPS pollution resulting from development, the most practicable method is the removal of particulate pollution by retention and slow release of runoff, or infiltration, supplemented by various at-site measures. Major questions remain as to where such practices would be employed, but these are covered in Section 7.0.





**APPENDIX 7:**

**OTHER PROGRAMS PROVIDING POSSIBLE PROTECTION  
TO THE DELAWARE ESTUARY**







## APPENDIX 7 OTHER PROGRAMS PROVIDING POSSIBLE PROTECTION TO THE DELAWARE ESTUARY

### Introduction

Although land use planning and control authority is primarily seated in local government, many other programs and agencies have the ability to affect NPS pollution. This appendix provides an overview of some of the most important, related programs.

### Parks, Wetlands and Scenic Rivers

Currently, the Delaware Estuary includes over 405,000 acres of wetlands and deepwater habitat. These sensitive areas fall under the jurisdiction of numerous local, state and Federal agencies. Federally and state protected areas are illustrated in the following map (see Figure 1 from the main report). The regions delineated as state parks, state wildlife areas and national wildlife refuges are protected under the appropriate state offices of fish and wildlife and parks and recreation, as well as Federal fish and wildlife authorities. All wetlands have a degree of control under the Corps of Engineers permit requirements and some state requirements.

An additional program which can assist in habitat preservation is the national Wild and Scenic Rivers Program. In 1987, New Jersey's Maurice River and its tributaries, the Manumuskin and Menantico Rivers, were entered, through Congressional approval, into the study process of the Wild and Scenic River System. The Maurice River system is the third largest tributary to the Delaware Estuary, behind the mainstem Delaware and Schuylkill Rivers. Thus, the condition of this river and activities throughout its contributing drainage area greatly affect the Estuary. With its inclusion in the national protection program, a cooperative effort among state and local governments, local residents and the Mid-Atlantic Office of the National Park Service will focus on a long-term protection strategy for the river corridor. The Wild and Scenic Rivers Program is an example of a program designed to address the cooperative aspects of environmental protection. Its most



beneficial aspect is the provision of a framework for decision-making specifically tailored to the needs and nature of a region.

#### **EPA Regulatory Controls of NPS Pollution**

Municipal stormwater runoff controls are presently applicable only to municipalities and separate counties having populations of over 100,000 served by separate sewers. An extension of the program to smaller municipalities has been postponed. This program is stated to have the ultimate objective to reduce pollutants in stormwater "to the maximum extent practicable." The progress towards the ultimate objective cannot be predicted and interim steps required are largely exploratory.

Under Section 402p of the Clean Water Act, control of runoff from industrial facilities is also required (overlapping the jurisdiction over municipalities referred to above). Discharges of runoff from the system must conform to applicable state and Federal effluent standards. However, during the first five years of the initial permit, requirements are much less.

Much, if not all, of the area necessary to be controlled under the DELEP Program will be part of the Coastal Zone and will be subject to controls under provisions of Section 6217 of the Clean Water Act. Like the municipal and industrial controls noted above, the coastal zone regulations also lack specificity.

These programs for Wild and Scenic Rivers, runoff control for industry and large municipalities, and coastal zone runoff control, plus EPA controls under other provisions of the Clean Water Act, are all aimed at reducing water pollution, as is the DELEP proposal; but there is no way to determine now what the specific effects of these programs will be upon the water quality and the habitat of the Delaware Estuary. On the other hand, the development of the DELEP Programs should be useful to the other regulatory programs by recommending specific minimum requirements for the purposes stated.

#### **Soil Erosion Control and Other Agricultural Control**

Soil and erosion control is a valuable, well-established program to control erosion and sediment wherever it may occur, but particularly in new construction. Technical requirements are implemented by



### **Stormwater Management**

Protection of the Delaware Estuary requires development of the water quality aspect of stormwater management as an important part of NPS control implementable through land use planning. In Delaware, water quality provisions of stormwater management are mandatory statewide. In Pennsylvania, no water quality aspect of stormwater management is required, except for streams draining into lakes. In New Jersey, regulations provide for the water quality aspect but it is not mandatory unless required by local ordinances, under the regulations of the Delaware and Raritan Canal Commission, or within the CAFRA area under a state permit. The Delaware Estuary program of water quality aspects of storm water management will require adequate criteria within the zone of influence and implementation by either a local or a state permit. In order to do this, the zone of influence must first be delineated.

### **NPS Control Strategy**

Each state has an NPS control strategy which has been approved by EPA and is in various stages of implementation. A NPS control strategy is not a regulatory program; it is implemented through whatever means the state finds appropriate. A NPS control strategy adopted as part of a Delaware Estuary Program would presumably become part of each state's NPS control strategy.

### **Wild and Scenic Rivers**

It is assumed that the Wild and Scenic Rivers Program (mentioned earlier in this Appendix) will continue to function as it does now under the supervision of the National Park Service. It will have to be verified that each plan adopted is sufficiently protective of the Delaware Estuary, since the main purpose of the Wild and Scenic Rivers Program is to protect the river in question and not the Estuary downstream.







Conservation Districts, in accordance with technology developed by the U.S. Soil Conservation Service and guidance from the States. It is not necessary for this report to redefine such practices. The usual deficiencies in applying such practices are mainly due to failure to implement rather than lack of guidance. This program has been aimed primarily at sediment and soil erosion programs rather than water pollution. The principal relationship with the Estuary program is that greater rigor in implementing established practices will be desirable in areas closely related to the Estuary.

Control of nonpoint source pollution by agriculture has been given attention by state and Federal agencies for some time. In the Estuary region, although certain volatile organics, so important to ground water, are of relatively little concern, control of nutrients and pesticides is particularly important. The greater part of agricultural land use does not give rise to much pollution (other than sediment and soil erosion) in either streams or aquifers, but there are some agricultural land uses which cause pollution problems. Attention must be focused on dairies, cattle feed lots (especially those located near streams), handling of manure, fertilizers, pesticides, and dead bird disposal. Relatively speaking, agricultural pollution is more important for the present than for the future, since developments in the Estuary region are tending towards urbanization, while acreages due to agriculture are expected to be reduced (except as more intensive farming practices may produce additional NPS loading). Experience in Wisconsin, in the Navesink Watershed in New Jersey, and in the West Branch of the Delaware River in New York indicates that pollution from animal wastes can be materially reduced, but careful attention must be given to working out the details in specific cases. Guidelines for proper use of agricultural fertilizers and pesticides are available and, if followed, should minimize NPS pollution.

Specific supplementary guidance concerning agriculture include the following:

- 1) Storage of manure in unlined pits or any underground disposition of barnyard runoff is apt to pollute ground water and should be avoided. The settlement of particulates is not adequate to remove such pollution, since the nitrates are not affected.
- 2) Any farm practices producing polluted runoff should be subject to stormwater management, including water quality-oriented detention.



- 3) Location of feed lots or holding pens closely adjacent to streams should be avoided.

The cooperation of Federal and state agricultural agencies should be obtained to locate sources of NPS pollution, prescribe proper BMPs and aid in enforcement.

The outlining of best management practices by agricultural agencies needs to provide special attention where runoff or infiltration will affect environmentally vulnerable areas. Management controls over agriculture have always been largely aimed at increasing long-term productivity and conserving soil and water. However, infiltration into ground water and reduction of pollution of surface water by agricultural practices are important. The NPS control measures required should be adjusted to consider the priority of the areas protected. However, this study is aimed at only NPS related to land use management. Other agricultural NPS controls are beyond the scope of this report.

Conservation Districts are often given authority to apply soil erosion and runoff control during construction activities and not just for agriculture but for all construction. This control is useful and necessary but more permanent measures are required for the DELEP. From the point of view of general NPS control and the DELEP, it is notable that the present agricultural control over fertilizers does not extend to parks, other public lands, golf course, homes and gardens.<sup>1</sup> In particular, it is common to fertilize lawns down to the water's edge, which leads directly to wash-off of nutrients. This appears to be a problem beyond the scope of the Conservation Districts, except possibly in an advisory capacity.

#### **Local Government Land Use Management**

In all three states, site plans and subdivision approval are controlled mainly by local institutions, by counties in unincorporated portions of Delaware, and elsewhere by municipalities. Analysis of existing situations in the Inventory and Assessment Report, December 1990, indicate that in the past such arrangements have not given sufficient weight to regional environmental priorities as compared to local economic interests.

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<sup>1</sup> In Delaware, control over use of agricultural fertilizers is voluntary.



However, there are such strong local concerns with land use planning, both environmental and economic, that local control is almost certain to continue. Therefore, it is concluded that the mechanics of site plan approval and subdivision development as well as the associated planning functions will continue to be carried out at local levels. If criteria and standards are established and maintained by the states and if a means for verifying compliance is provided, environmental objectives, including NPS control of new developments, should be achievable through locally managed land use controls.

### **Agricultural and Soil Erosion Control**

Governmental arrangements for soil erosion and sedimentation control in connection with agriculture are of long standing. They have more recently been extended to soil erosion and sediment control from construction in general. These programs are a necessary part of any NPS control program and are implemented by Conservation Districts, under Federal and state supervision. They are supported by agricultural extension services and it is assumed that these agencies will continue to exercise such functions. The acreage in agriculture in the Estuary region is relatively static, or decreasing, so land use management deals (other than changes in the cropping system) with relatively few new developments of an agricultural nature. The continuation of these arrangements for agriculture is considered another basic part of the proposed structural analysis for the DELEP. It is necessary that such developments be given appropriate examination for NPS control in the light of whatever criteria are approved.

### **Municipal and Industrial Permits**

Under the Clean Water Act, new programs are being established to meet water quality targets of storm runoff by combinations of point source and nonpoint source controls. These permits are now to be required in the Delaware Estuary Region for many industrial sites, for the city of Philadelphia and for the county of New Castle in Delaware and later, presumably, for other municipalities and counties. These programs will require the designated entity to exercise control of runoff from both existing and future development under requirements imposed by the state and EPA. This institutional channel could not be changed by reason of the





Delaware Estuary program. It is assumed, however, that requirements to protect the Delaware Estuary from NPS pollution could be taken care of as one of the conditions of these permits.

### **Existing Coastal Zone Management Programs**

All three states have coastal zone management programs, described in Briefing Paper No. 1: Delaware Estuary Environmental Problems and Existing Land Use Management Programs. The objectives of coastal zone management coincide to a considerable extent with those of the DELEP. The coastal zone management program is fully developed mainly for the CAFRA area of New Jersey and in neither New Jersey nor Pennsylvania does it encompass an area large enough for adequate control of NPS pollution for the DELEP program. However, within areas where it has authority, each coastal zone management agency would be an appropriate agency to implement provisions such as protection of sensitive habitat or certain other planning aspects. This option is covered in more detail in the following section.

### **Coastal Zone NPS Control**

Under provisions of the Clean Water Act, Section 6217, each coastal zone state is required to develop a coastal zone NPS control program. As discussed in Briefing Paper No. 2: Discussion of Land Use Control Options to Protect Delaware Estuary Water Quality, the program now being developed for the Delaware Estuary is in almost every respect consistent with EPA guidance for the new coastal zone program. Presumably, when the coastal zone NPS programs of New Jersey, Pennsylvania, and Delaware are formulated, they will be required to include provisions protective of the Delaware Estuary. Therefore, the present study can be viewed as a forerunner from the viewpoint of establishing criteria and standards of NPS control. As regards implementation, coastal zone management in New Jersey and Pennsylvania would need to be extended geographically in order to implement an adequate area of NPS control as outlined by the zone of influence, or supplementary institutional and regulatory arrangements will be necessary to provide full geographic coverage. How coastal zone NPS control is to be implemented is a question that each state government must decide.

